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THE ROLE OF NONPACKAGING PAPER IN SOLID WASTE MANAGEMENT 1966 TO 1976

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The proportions of nonpackaging paper tonnage that entered the solid waste stream in 1966 and that would do so in 1976 were established. Nonpackaging paper includes such items as newsprint, printing papers, stationery, towels, and household tissues, construction paper and board, and nonwoven disposables. Qualitative and quantitative information about nonpackaging paper was acquired and evaluated to arrive at forecasts of consumption in 1976. Disposal characteristics and rates are discussed. Calculations indicated that 14.3 million tons reached disposal sites in 1966 and this amount is expected to increase by 6.3 million tons by 1976. In pounds per capita, discarded paper will increase from 200 lb in 1966 to 250 lb in 1976, a net change of 25 percent.

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THE ROLE OF NONPACKAGING PAPER IN SOLID WASTE MANAGEMENT, 1966 TO 1976

PART I: Introduction
PART II: The Outlook for Nonpackaging Paper, 1966 to 1976
PART III: The Impact of Nonpackaging Paper on Solid Waste

This publication SW–26c was written for the Solid Waste Management Office by

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Midwest Research Institute, Kansas City, Missouri
under Contract No. PH 86–67–114

U.S. ENVIRONMENTAL PROTECTION AGENCY
Solid Waste Management Office
1971

FOREWORD

A report was published in 1969 by the Bureau of Solid Waste Management* to describe the likely role of packaging in solid waste management during the decade 1966 to 1976. The present publication supplements that study and, like that one, was written on contract with Midwest Research Institute. In the first study it was found that packaging paper and paperboard accounted for almost 50 percent of the ultimate consumption of all paper products. Inevitably, some of the data accumulated in the course of that study related to the remainder of the paper industry's output. Moreover, paper products of all types comprise over half of all community solid wastes—household, institutional, commercial, and industrial. There was every reason, therefore, to extend the original survey to cover nonpackaging paper.

Nonpackaging paper includes such items as newsprint, printing papers, stationery, towels and household tissues, construction paper and board, and a rapidly expanding category in which paper is a major component, namely nonwoven disposables. The present report surveys the consumption outlook for all these categories of nonpackaging paper for the same decade covered by the first report. Their impact on solid waste mangement is analyzed. This required determining the life cycles of the various categories.

It was found that most packaging paper became waste within the same year of use, indeed frequently within the same month. Some nonpackaging paper—such as facial tissue—becomes waste immediately upon use. On the other hand, various other nonpackaging papers remain out of the waste stream for many years. This applies to hardbound books and building paper and board, much of which becomes waste only when a building comes down. Determining these varied life cycles of nonpackaging paper was necessary in order to calculate the quantities of solid waste derived from all paper (packaging and nonpackaging); this was estimated to be almost 35 million tons in 1966 and over 51 million tons in 1976.

Paper salvaged is resources saved. Salvage and recycling of wastes conserve resources and at the same time reduce the burden of solid wastes requiring disposal within the environment. While the present report indicates that some 10 million tons of paper stock for industry use derive from salvage, the Bureau of Solid Waste Management believes that this figure may be substantially increased through market development and technological advances. With this in view the Bureau has initiated several efforts to enlarge the prospects for salvage; one such effort is a recent contract for an economic study of salvage markets for all the major commodities within community solid wastes—ferrous and nonferrous metals, glass, wood, textiles, and rubber, as well as paper and paperboard. It has been noted, too, that industry, individually and jointly, is proceeding to give greater attention to the subject of salvage.

The present report makes a significant contribution to our knowledge about a major constituent of solid wastes. Leander B. Lovell, Senior Economist, was the Bureau's project officer for this and the report on packaging which preceded it.

—RICHARD D. VAUGHAN
Assistant Surgeon General
Acting Commissioner
Solid Waste Management Office

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*The Bureau of Solid Waste Management, often termed "the Bureau" in this report, is now the Solid Waste Management Office of the U.S. Environmental Protection Agency.

This is an Environmental Protection Publication

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PREFACE

This report on the role of nonpackaging paper in solid waste, for the period of 1966 to 1976, was prepared by Midwest Research Institute pursuant to Contract No. PH 86–67–114, with the Bureau of Solid Waste Management, U.S. Department of Health, Education, and Welfare, now the Solid Waste Management Office of the U.S. Environmental Protection Agency. The statements, findings, and other data in this report do not necessarily reflect the views of the Environmental Protection Agency.

Principal investigators were Arsen Darnay, project manager, and William E. Franklin. Valuable staff support was provided to the investigators by Margaret Cossette and James M. Bednar. Technical editing was done by Valerie Lee. John McKelvey, Assistant Director, Economic Development Division, had responsibility for general supervision of the project.

Many individuals and organizations provided information, advice, commentary, and suggestions to the research team. We should like to express our thanks and appreciation to all those who collaborated in this enterprise.

ACKNOWLEDGMENTS

A study effort encompassing the paper industry and others which influence the consumption of paper could not have been accomplished without the active participation and assistance of many companies, associations, and independent researchers. The cooperation and help given to the research team by all these organizations has been outstanding. We are pleased to acknowledge our indebtedness to all for the value of this report, while retaining full responsibilities for errors and omissions.

The direct contacts made during this study were extensive but we should like to acknowledge a special debt to the following companies:

American Hardboard Association
20 Wacker Drive
Chicago, Illinois 60606

R. R. Donnelley & Sons Company
2223 South Parkway
Chicago, Illinois 60616

IBM
Two Pennsylvania Plaza
New York, New York 10016

International Paper Company
220 East 42nd Street
New York, New York 10017

McCall Corporation
McCall Street
Dayton, Ohio 45401

Newsprint Division
American Paper Institute, Inc.
260 Madison Avenue
New York, New York 10016

Oxford Filing Supply Co., Inc.
Clinton Road
Garden City, New York 11530

Printing-Writing Paper Division
American Paper Institute
260 Madison Avenue
New York, New York 10016

St. Regis Paper Company
150 East 42nd Street
New York, New York 10017

NONPACKAGING PAPER

Saxon Industries, Inc.
450 Seventh Avenue
New York, New York 10001

Standard Register Company
626 Albany Street
Dayton, Ohio 45401

Time, Inc.
Rockefeller Center
New York, New York 10020

Tissue Division
American Paper Institute
260 Madison Avenue
New York, New York 10016

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PART I

INTRODUCTION

PART I

THE ROLE OF NONPACKAGING PAPER IN SOLID WASTE MANAGEMENT, 1966 TO 1976

In 1966, a total of 52.4 million tons of paper were consumed in the United States, amounting to approximately 533 lb per capita. Of this, 27.3 million tons (52.1 percent) were consumed in nonpackaging applications (277.5 lb per capita). This report is concerned with the nonpackaging portion of paper and paperboard.

The study is a logical outgrowth of a previous study done by Midwest Research Institute (MRI) for the Federal solid waste's program on *The Role of Packaging in Solid Waste Management, 1966 to 1967*. This report, together with those sections in the earlier report that discuss paper and paperboard consumed in packaging applications, cover essentially all the paper and paperboard consumed in the United States each year. Data assembled on the consumption of all packaging and nonpackaging grades of paper and paperboard for 1966 clearly show that paper and paperboard are large contributors to the volume of solid waste (Table 1).

TABLE 1.—*Consumption of paper and paperboard by grade and application: 1966**

(In thousands of tons)

Grade	Packaging	Non-packaging	Total
Paper:			
Newsprint	—	9,093	9,093
Printing paper	899	5,764	6,663
Fine paper	—	2,697	2,697
Coarse paper	4,717	—	4,717
Special industrial paper	188	916	1,104
Tissue, except sanitary and thin	236	—	236
Sanitary tissue	—	2,825	2,825
Total paper	6,040	21,295	27,335
Paperboard:			
Paperboard	19,067	1,903	20,970
Wet machine board	—	156	156
Construction paper and board	—	3,967	3,967
Total paperboard	19,067	6,026	25,093
Total all grades	25,107	27,321	52,428

*Source: Midwest Research Institute.

OBJECTIVES

The primary objective of this study was to determine what portion of the nonpackaging grades of paper and paperboard would be a part of the solid-waste stream in 2 base years: 1966 and 1976. Pursuit of this objective involved four basic tasks: (1) development of the historical consumption of nonpackaging paper and paperboard from 1958 to 1966; (2) analysis of the techno-economic factors that influence the consumption of nonpackaging paper and paperboard; (3) forecasting of the consumption to 1976 for each grouping of nonpackaging paper and paperboard; (4) estimation of the proportion of paper and paperboard tonnage that reached solid waste disposal facilities in 1966 and that will reach disposal facilities in 1976.

ORGANIZATION OF THIS REPORT

This section (Part I) is followed by two more sections.

Part II begins with a description of the methods employed in analyzing each of the major paper grades to arrive at forecasts of consumption in 1976. Then, each of the major paper grades is discussed separately and special emphasis is placed on the techno-economic trends that influence the consumption pattern for each particular grade. Finally, the forecast for each grade is presented.

Part III is a discussion of the disposal characteristics of the paper grades analyzed in this report. Again, the general approach is presented first, fol-

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lowed by the disposal rates for each category. These disposal rates help to characterize the life cycle of paper and paperboard products. The last section of Part III is an estimate of the quantities of paper and paperboard that reached disposal sites in 1966 and that will reach disposal sites in 1976.

At the end of the report are a bibliography and an appendix.

PART II

THE OUTLOOK FOR NONPACKAGING PAPER, 1966 TO 1976

PART II

THE OUTLOOK FOR NONPACKAGING PAPER, 1966 TO 1976

METHODOLOGY

In this section some general descriptions are given of the methods used to develop the forecasts presented later in this report. In an industry whose products find such a variety of applications it is not practical to trace the method by which each specific forecast was made. However, some general guidelines can be set down.

Approach

The basis for the quantitative aspects of this study was the U.S. Government's Standard Industrial Classification (SIC). In this case, basic statistical data come from SIC's major group 26, "Paper and Allied Products." The historical data were developed from the Bureau of the Census Current Industrial Report series M26A, "Pulp, Paper, and Board." In addition, the Business and Defense Services Administration Quarterly Industry Reports series M26A "Pulp, Paper, and Board" were used to obtain import-export data.

The nonpackaging paper grades were identified, and consumption data for the 1958 to 1967 period were developed in as much detail as available at the seven-digit SIC level. (In this study consumption is defined as domestic production plus imports minus exports.)

We acquired and evaluated both quantitative and qualitative information about nonpackaging paper to make judgments about the most likely developments in paper. Forecasts to 1976 were prepared for seven-digit SIC grades that are identified as major categories in the basic statistical sources. Most consumption figures for nonpackaging paper are expressed in thousands of tons.

Various organizations have published forecasts of paper consumption to the mid-1970's and beyond, most notably the American Paper Institute (API) and the U.S. Forest Service. The API and Forest Service have developed their forecasts using trend analysis and regression correlations with gross national product (GNP), disposable personal income (DPI), per capita GNP or DPI, industrial production index, construction activity, and population. The forecasts of these organizations for the 14 major (five-digit SIC) groupings to the mid-1970's are in substantial agreement. These forecasts are generally accepted by the paper and paperboard industry, and have been reasonably accurate in the past.

The forecasts of these two organizations were basic to the MRI analyses. In addition, MRI made its own projections based on rates of change between 1958 and 1966, and forecasts were developed at seven-digit levels for nonpackaging paper. These initial forecasts were then reevaluated on the basis of MRI's analysis of techno-economic trends. Thus, the MRI forecasts include modifications that appear justified by trends in technology and are considerably more detailed than some of the forecasts available from other sources.

Primary attention was given to techno-economic trends that would have an impact on future consumption of paper. After identification of a significant development, four general questions formed the basis for qualitative analysis: How probable is it that the development will actually materialize? What would be the effects on the quantity, quality, production and conversion technology, and marketing of paper? What would be the most likely quantitative effect on consumption? What would be the time-rate relations of the change?

We judged the effect of basic trends and other factors on consumption in tonnage of a specific grade and made adjustments that would not be detected in a general trend analysis.

Throughout the analysis of nonpackaging paper, emphasis was placed on identifying those forces—technological, economic, marketing, and sociological—that will have the greatest impact to the mid-1970's. Various demand determinants—communications technology, office machines, the potential market for nonwoven disposables, and construction activity—were basic factors in the analysis. Par-

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ticular attention was given to those paper grades that have the greatest impact on solid waste. In addition, we estimated the rate at which paper grades enter the solid waste stream, because in nonpackaging paper, rates vary greatly with the end use for which paper is intended.

Part II results in a forecast of paper consumption by grade, which serves as the basis for establishing solid waste quantities in 1966 and 1976, the subject of Part III.

Data Sources

The major sources of statistical data have already been cited. The qualitative analysis was also based on literature derived from trade press sources. Through field visits and telephone interviews, MRI made extensive contacts with industry officials in the American Paper Institute, major paper companies, and other companies whose products influence paper consumption. The final forecasts and evaluations, while reflecting the views of these sources, are MRI's and do not necessarily correspond to those of persons contacted.

General Background and Assumptions

General trends in nonpackaging paper have been fairly well established, but there are limitations to any 10-year forecast. Research now under way is likely to lead to developments which are not now of significance; other developments may not materialize as fully as expected. Variations are more likely to show up in a specific area, however, than in a major grade as a whole, and the overall impact of these variations should not change the basic trends significantly.

As in most studies of this type, background assumptions were made about general environmental conditions. For example, it was assumed that the U.S. economy would continue to show the relatively stable conditions experienced in the last 10 years, and that serious dislocation would not occur. The general growth of the gross national product and output of goods was based on accepted government forecasts of about 4 percent per year real growth. Population growth was assumed to be slower than in previous years, and the second lowest rate of growth published by the Bureau of Census was used. In addition to assumptions about the general environment, MRI forecasts were based on certain assumptions about the forces at work in the paper industry today and the most likely conditions a decade hence. Specifically, no adjustments were made for the impact on paper of Federal or local programs aimed at easing the solid waste or litter burden created by paper; any such programs initiated before 1976 may have considerable influence on paper consumption.

The section immediately following this one presents an overview of all nonpackaging paper and paperboard: major grades, characteristic end uses, and overall consumption trends. The remaining sections discuss the historic trends, characteristics, and forecasts for each of the nine major grades, with particular attention to techno-economic trends.

OVERVIEW: COMPONENTS OF NONPACKAGING PAPER

There are nine major nonpackaging paper and paperboard grades. They are used in a wide variety of products, ranging from the daily newspaper to components for residential and commercial buildings. The majority of these grades, however, are used for some type of product on which printing appears. There are five major grades of paper and four major grades of paperboard, with thousands of end uses.

Paper

Newsprint: A low-quality paper used primarily for newspapers.

Printing paper: Coated and uncoated papers used in periodicals, directories, books, and commercial printing.

Fine paper: High-quality papers used for such business applications as stationery, forms, reports, records, and the like.

Special industrial paper: Coarse papers used for a variety of specialized applications such as tabulating cards, filters, and absorbent papers.

Sanitary tissue: Thin and relatively soft papers used for personal products such as napkins, toilet paper, and facial tissue.

Paperboard

Special paperboard: Rigid grades of varying thicknesses that are used for construction papers and a variety of products (book matches, book bindings, auto panel board, posters, etc.) made from bending and nonbending boards and cardboard.

Wet machine board: A specialized type of paperboard (usually ¼- to ⅜-in. thick) produced by a special process for use in such products as shoes, book bindings, and gaskets.

Construction paper: Heavy papers that are further processed into construction products; the predominant use is for roofing felts.

Construction board: Paperboard used in construction. The lighter densities are used as insulation board, interior wallboard, acoustical tile, and the like. Heavier densities, known as hard pressed board, are used for wall paneling, furniture, and a variety of other products.

TABLE 2.—*Consumption of nonpackaging paper and paperboard by grade: 1966**

(In thousands of tons)

Grade	Total consumption	Percent of total
Paper:		
Newsprint	9,093	33.3
Printing paper	5,764	21.1
Fine paper	2,697	9.9
Special industrial paper	916	3.3
Sanitary tissue	2,825	10.3
Total paper	21,295	77.9
Paperboard:		
Special paperboard	1,903	7.0
Wet machine board	156	0.6
Construction paper	1,505	5.5
Construction board	2,462	9.0
Total paperboard	6,026	22.1
Total all grades	27,321	100.0

*Source: Midwest Research Institute.

In 1966 the total tonnage involved in each of the nine major grades varied widely—from 0.15 million tons of wet machine board to 9.1 million tons of newsprint (Table 2). About 78 percent of the tonnage was in the form of paper. In terms of total tonnage, the most significant grades are newsprint and printing paper, which alone account for more than half of all nonpackaging paper and paperboard.

Impact of Imports and Exports on Consumption

In determining consumption of all grades of nonpackaging papers, the impact of imports and exports was taken into account. The impact of imports and exports is very minor except for a few grades such as newsprint and hard pressed board. Newsprint accounts for over 90 percent of the adjustment required by taking imports and exports into account.

The use of the term "consumption" should be clarified as it applies to paper and paperboard grades. In general, consumption, which is commonly referred to as "apparent consumption," is calculated by the following simple equation:

Consumption=Domestic Production
+Imports—Exports

Thus consumption does not take into account inventory adjustments which take place during a year at several levels—mill, converter, wholesale, or retail. In general, this definition of consumption is entirely adequate and does not introduce appreciable errors in expressing actual consumption.

General Trends in Nonpackaging Paper Consumption

Consumption of paper has usually paralleled general economic conditions. The continued growth of paper consumption is almost a certainty. Although the rate of growth of many grades of paper is tending to slow as certain markets reach saturation, others are experiencing a much more rapid growth as new markets open up to them. In general, the growth curve for paper appears to be flattening somewhat, but the consumption of nonpackaging paper and paperboard on a tonnage basis will still grow at about 3.2 percent per year compared with a 4-percent GNP growth rate commonly forecast for the years ahead. Table 3 is a summary of consumption for all paper for 1966 and 1976. Table 4 is a capsule summary of consumption of all paper by grades for packaging and nonpackag-

TABLE 3.—*Paper and paperboard consumption: 1966 and 1976**

(In thousands of tons)

	1966	1976	Rate of change 1966–76 (percent)
Packaging grades	25,107	36,895	3.9
Nonpackaging grades	27,321	37,545	3.2
Total	52,428	74,440	3.6

*Source: Midwest Research Institute.

TABLE 4.—*Consumption of paper and paperboard by grades: 1958–1976**

(In thousands of tons)

Category	1958	1966	1976
Paper:			
Newsprint	6,515	9,093	11,400
Printing paper, nonpackaging	3,489	5,764	8,210
Printing paper, packaging	544	899	1,285
Fine paper	1,506	2,697	3,800
Coarse paper, packaging	3,656	4,717	5,890
Special industrial, nonpackaging	531	916	1,085
Special industrial, packaging	132	188	270
Sanitary tissue, nonpackaging	1,700	2,825	4,670
Tissue, packaging	220	236	200
Total paper	18,293	27,335	36,810
Paperboard:			
Paperboard, packaging	12,040	19,067	29,250
Special paperboard, nonpackaging	1,339	1,903	2,550
Wet machine board	121	156	180
Construction paper and board	3,104	3,967	5,650
Total paperboard	16,604	25,093	37,630
Total paper and paperboard	34,897	52,428	74,440

*Source: Midwest Research Institute.

TABLE 5.—*Consumption of nonpackaging paper and paperboard grades in percent: 1966 and 1976**

(Based on tonnage)

Paper grade	1966	Percent	1976	Percent
Newsprint	9,093	33.3	11,400	30.4
Printing paper	5,764	21.1	8,210	21.9
Fine paper	2,697	9.9	3,800	10.1
Special industrial paper	916	3.3	1,085	2.9
Sanitary tissue	2,825	10.3	4,670	12.4
Special paperboard	1,903	7.0	2,550	6.8
Wet machine board	156	0.6	180	0.5
Construction paper	1,505	5.5	1,820	4.8
Construction board	2,462	9.0	3,830	10.2
Total	27,321	100.0	37,545	100.0

*Source: Midwest Research Institute.

ing categories and gives a more detailed overview of consumption of paper in the United States.

The consumption of nonpackaging paper and paperboard grew from 18.3 million tons in 1958 to 27.3 million tons in 1966. By 1976, consumption is forecast at 37.5 million tons, a growth rate of 3.2 percent per year from 1966 to 1976. A summary of consumption of the nine major nonpackaging paper and paperboard categories for 1966 and 1976 is given in Table 5. Table 6 is a detailed summary for the period 1958 to 1976; this information is shown graphically in Figures 1 and 2. Table 7 is a summary of consumption on a per capita basis. There is considerable variation in the growth rates expected, and many of the grades that reach disposal sites most rapidly are expected to experience a relatively high growth rate in the years ahead.

NEWSPRINT

Newsprint is the most significant of all nonpackaging paper grades in terms of quantity. In 1966, consumption was 9.1 million tons, which accounted for one-third of the total consumption of nonpackaging paper and paperboard. By 1976, newsprint will still account for more than 30 percent of the total.

Newsprint is used almost exclusively for one product—newspapers. About 93 percent of newsprint goes into daily and weekly, local and national newspapers and Sunday supplements. The rest of the newsprint is used for comic books, handbills, sales books, and other printed items.

Typical newsprint is composed of 75 percent groundwood pulp and 25 percent chemical pulp. This combination produces a paper of low quality. Quality is not too important, however, because products made from newsprint are usually discarded within a few days or even hours after they are printed.

Of all the major paper grades, newsprint is the only one that is supplied primarily from imports. In 1967, 6.60 million tons of the newsprint consumed in this country was imported. Of this amount, almost all (6.32 million tons) came from Canada.

Techno-Economic Trends

Because newspapers account for such a large portion of newsprint consumption, the history and outlook of newsprint are reflections of the history and outlook of newspapers.

Newspapers are a basic part of our communications media. Although television and growing suburban populations have altered the character of the newspaper industry, they have not had an adverse

TABLE 6.—*Consumption of nonpackaging paper and paperboard by major grades: 1958–1976**

(In thousands of tons)

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1970	1976	Rate of change 1966–1976(%)
Paper:													
Newsprint	6,515	7,037	7,312	7,386	7,456	7,577	8,092	8,442	9,093	8,864	9,700	11,400	2.3
Printing paper	3,489	3,880	4,071	4,064	4,249	4,512	4,829	5,219	5,764	5,622	6,615	8,210	3.6
Fine paper	1,506	1,735	1,747	1,899	2,038	2,086	2,201	2,417	2,697	2,613	3,100	3,800	3.6
Special industrial paper	531	622	622	681	741	738	783	838	916	874	1,025	1,085	1.7
Sanitary tissue	1,700	1,855	1,939	2,061	2,161	2,319	2,483	2,614	2,825	2,902	3,480	4,670	5.1
Paper, total:	13,741	15,129	15,691	16,091	16,645	17,232	18,388	19,530	21,295	20,875	23,920	29,165	3.2
Paperboard:													
Special paperboard	1,339	1,478	1,500	1,659	1,560	1,647	1,691	1,864	1,903	1,856	2,115	2,550	3.0
Wet machine board	121	147	177	155	147	140	153	150	156	138	160	180	1.5
Construction paper	1,379	1,441	1,397	1,376	1,419	1,449	1,527	1,575	1,505	1,601	1,650	1,820	1.9
Construction board	1,725	2,017	1,870	1,934	2,080	2,254	2,454	2,558	2,462	2,220	3,000	3,830	4.5
Paperboard, total:	4,564	5,083	4,944	5,124	5,206	5,490	5,825	6,147	6,026	5,815	6,925	8,380	3.4
Paper and paperboard, total:	18,305	20,212	20,635	21,215	21,851	22,722	24,213	25,677	27,321	26,690	30,845	37,545	3.2
Nonwoven disposables							NA†	NA†	(40)‡	(50)‡	75	200	17.5

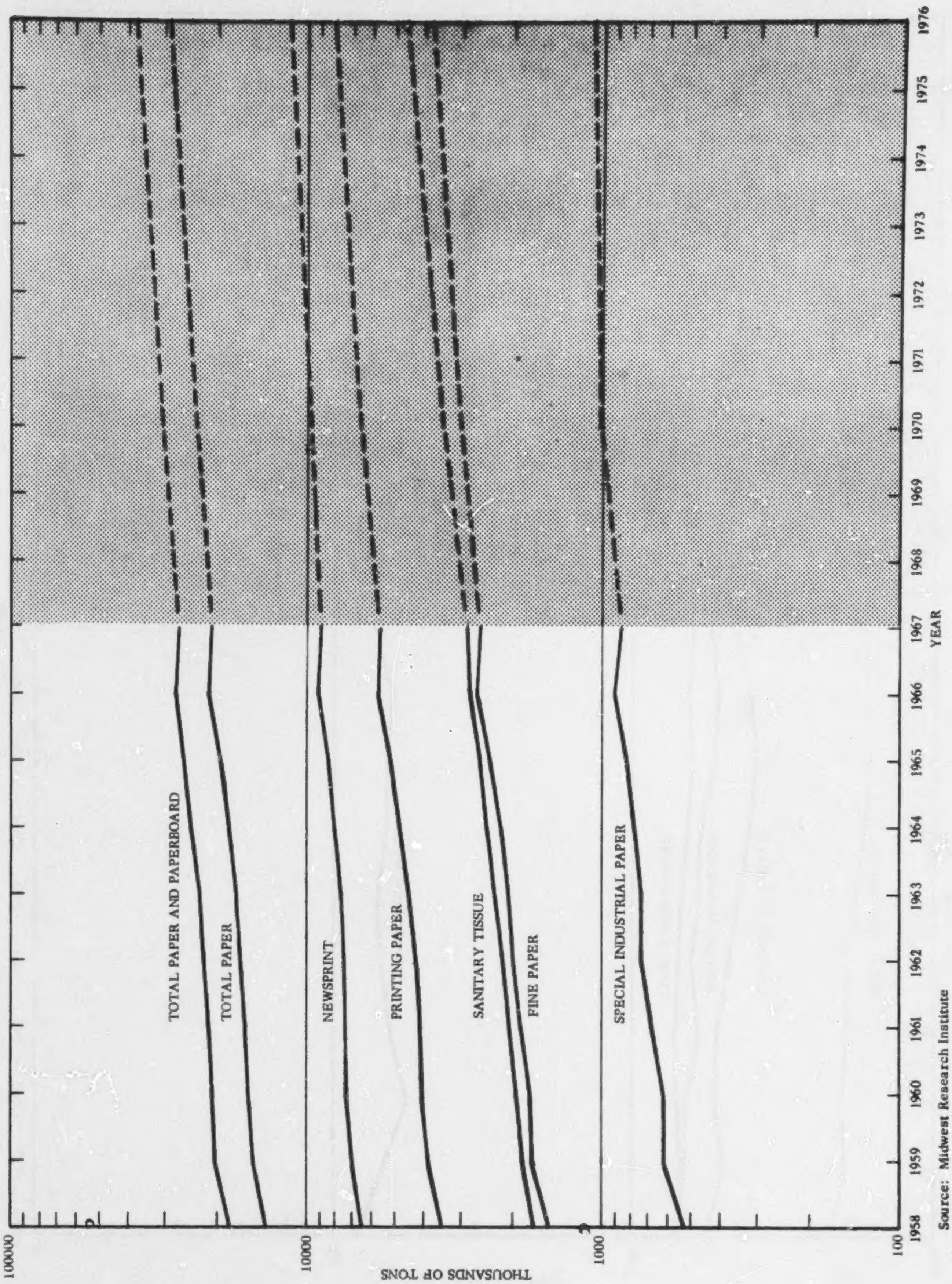
*From: U.S. Department of Commerce, Business and Defense Services Administration, Pulp, paper, and board, *Quarterly Industry Report*. 24(1):23–27, Apr. 1968
U.S. Department of Commerce, Bureau of the Census, Pulp, Paper, and Board, *Current Industrial Reports*. Series M26A(60–13)—M26A(66–13). Washington, 1961–1967.
Import/export adjustments and forecasts by Midwest Research Institute.
†NA = Not available.
‡Estimates are in parenthesis.

TABLE 7.—*Per capita consumption of nonpackaging paper and paperboard by major grades: 1958–1976**

(In pounds)

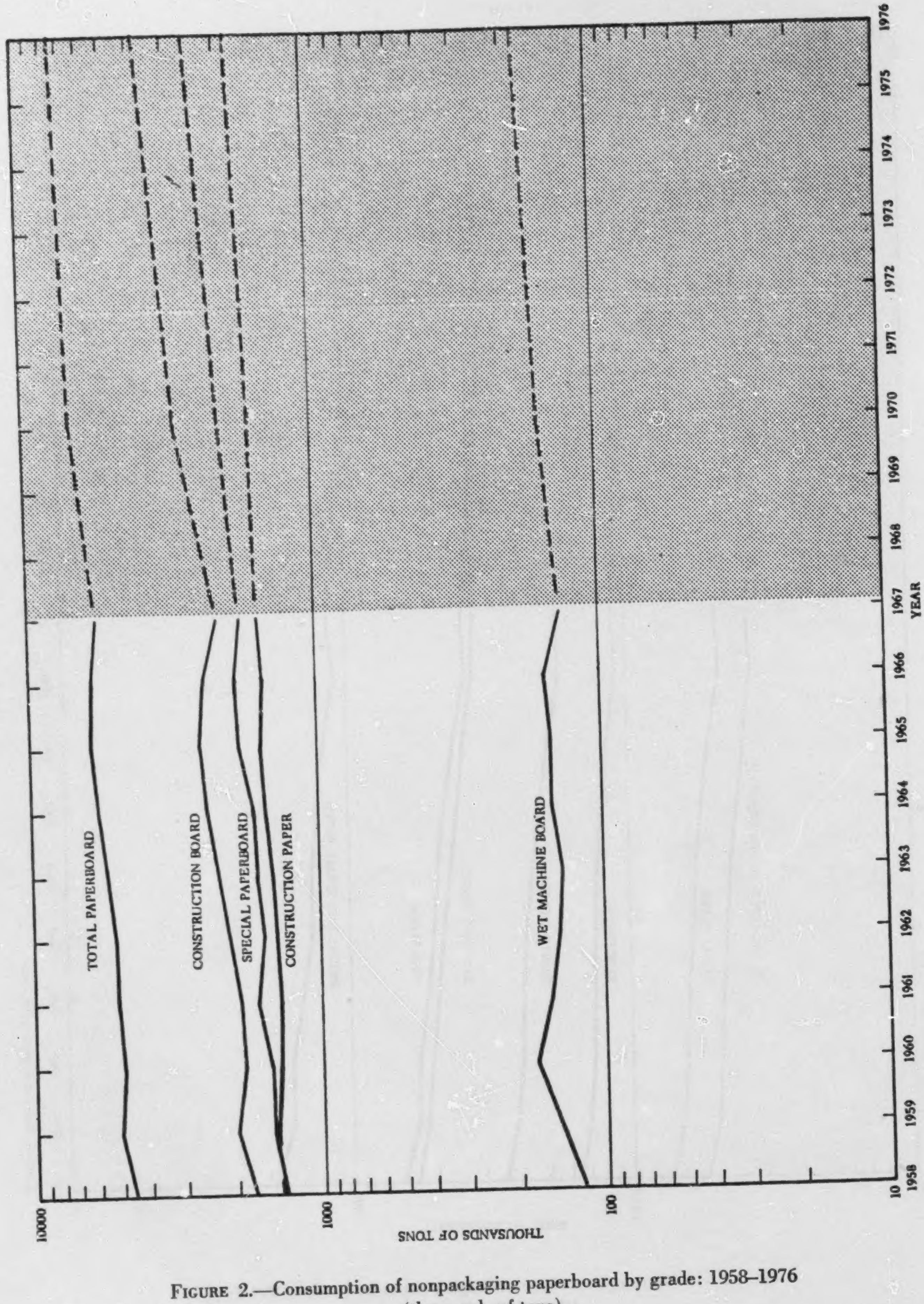
	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1970	1976
Paper:												
Newsprint	74.9	79.5	80.9	80.4	79.9	80.0	84.2	86.8	92.4	89.6	94.2	102.5
Printing paper	40.1	43.8	45.1	44.2	45.5	47.6	50.3	53.6	58.6	56.8	64.2	73.9
Fine paper	17.3	19.6	19.3	20.7	21.8	22.0	22.9	24.8	27.4	26.4	30.1	34.2
Special industrial paper	6.1	7.0	6.9	7.4	7.9	7.8	8.2	8.6	9.3	8.8	9.9	9.8
Sanitary tissue	19.5	20.9	21.5	22.4	23.2	24.5	25.8	26.9	28.7	29.3	33.8	42.0
Paper, total:	157.9	170.8	173.7	175.1	178.3	181.9	191.4	200.7	216.4	210.9	232.2	262.4
Paperboard:												
Special paperboard	15.4	16.7	16.6	18.1	16.7	17.4	17.6	19.2	19.3	18.8	20.5	22.9
Wet machine board	1.4	1.7	2.0	1.7	1.6	1.5	1.6	1.5	1.6	1.4	1.6	1.6
Construction paper	15.8	16.3	15.5	15.0	15.2	15.3	15.9	16.2	15.3	16.2	16.0	16.4
Construction board	19.8	22.8	20.7	21.0	22.3	23.8	25.5	26.3	25.0	22.4	29.1	34.5
Paperboard, total:	52.4	57.5	54.8	55.8	55.8	58.0	60.6	63.2	61.2	58.8	67.2	75.4
Paper and paperboard, total:	210.3	228.3	228.5	230.9	234.1	239.9	252.0	263.9	277.6	269.7	299.4	337.8

*From Table 6 (preceding page). U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-25, No. 372, August 21, 1967, and No. 359, February 20, 1967, Washington, D.C.



Source: Midwest Research Institute

Figure 1.—Consumption of nonpackaging paper by grade: 1958–1976 (thousands of tons).



Source: Midwest Research Institute

FIGURE 2.—Consumption of nonpackaging paperboard by grade: 1958–1976 (thousands of tons).

effect on the growth of that industry. Newsprint consumption has grown almost continuously for the last 20 years.

The major factors influencing the circulation of newspapers and thus the consumption of newsprint are advertising content and the size of the adult population. Advertising accounts for approximately 60 percent of the average content of newspapers. In the last few years, newspapers which had lost ground with respect to other media in total advertising income, have stabilized their share at about 29 percent of total annual advertising expenses. With an expanding GNP to stimulate advertising, and a growing educated adult population in the 1970's, most industry experts foresee a continued growth for newspapers. Table 8 presents data on various measures of growth for the newspaper industry between 1958 and 1967.

Several significant technological changes are taking place in the newspaper industry and should be important factors well into the 1970's. These developments will have their greatest impact on newspaper production techniques. For example, the adaptation of the offset printing process to newspaper printing has enabled many of the small, local-circulation newspapers to stay in business. Also, offset is particularly adaptable to automation and will permit newspapers to be produced more rapidly and at a lower cost in the 1970's. Offset is now used by 400 of the nearly 1,750 newspapers in the United States. By 1976, perhaps three-fourths of all the daily newspapers will be using offset.

TABLE 8.—*Measures of growth for newspapers: 1959–1967**

Category	1959	1967	Percent change
Newsprint consumption—thousand tons	7,037	8,864	+26
Newsprint consumption—pounds per capita	79.5	89.6	+13
Total circulation daily papers—million	58.3	61.4†	+5
Circulation per household	1.12	1.05	−6
Advertising lineage—million lines (52 cities)	2,865	3,297	+15
Advertising expenditures in newspapers—millions of dollars	3,564	4,942	+39
Newspaper advertising as a share of total advertising	0.317	0.293	−8

*From U.S. Bureau of the Census. Statistical abstract of the United States: 1968, 89th ed., Washington, 1968. Tables 6 and 7.

†1966 circulation.

Another important technological development is the application of computers to newspaper production and distribution. At present, the computer is important only in the area of typesetting, but it is expected to move into makeup, printing-press control, mailroom handling, and other areas. The computer should contribute greatly to efficiency and speed in newspaper production.

Other significant technological developments that may affect newspaper production are the use of cathode ray tube generators for setting type and the establishment of satellite production plants. These satellite plants would be located in the suburbs and use facsimile transmission of whole pages from a central location. Such plants would be able to incorporate local advertising and focus more attention on the local suburban market.

Forecast

In the period from 1966 to 1976 it is unlikely that these technological developments will have any significant impact on present trends in newsprint consumption. Shifts in GNP, which would be reflected in advertising revenues of newspapers, would, of course, affect per capita consumption. However, this analysis is based on the assumption that the GNP will have a steady rate of growth in the forecast period.

MRI's forecast for newsprint consumption in 1976 is in line with those made by the newspaper and paper industries. By 1976, newsprint consumption will be at 11.4 million tons, about 103 lb per capita. The 1967 figures were 8.9 million tons, about 90 lb per capita.

PRINTING PAPER

Printing paper is the second largest grade of nonpackaging paper. In 1966, it accounted for 5.76 million tons or 21.1 percent of total nonpackaging paper consumption.

There are two basic grades of printing paper: groundwood paper and book paper. These papers almost always appear in some printed form, such as a magazine, or as a product designed to receive printing during its useful life, such as an adding-machine tape.

Groundwood paper is similar to newsprint and contains at least 25 percent of mechanically produced wood pulp; the remainder is chemically produced wood pulp. Groundwood papers are used for products where permanence and strength are not important but where absorbency, bulk, opacity, and the ability to take a clear impression are important. Typical products include telephone books, directories, inexpensive novels, and magazines.

Book papers are made from combinations of bleached, chemically produced wood pulp. Uncoated book paper is most suitable for graphic arts and is widely used for books and commercial printing. It is also converted into products such as envelopes, writing tablets, and adding-machine paper.

Both groundwood paper and book papers may be coated for printing. Coated papers have a better appearance and are especially desirable when halftone illustrations are to be used. Coated papers are used primarily for magazines, books, pamphlets, brochures, and folders. The coating is usually a mixture of an adhesive and a white mineral pigment such as clay, barium sulfate, calcium carbonate, calcium sulfate, or titanium oxide.

The consumption of coated book and groundwood papers has risen sharply in recent years. In 1958, 1.41 million tons were consumed. By 1966 consumption had increased by 89 percent to 2.66 million tons (Table 9, Figure 3). In contrast, the consumption of uncoated groundwood paper increased 40 percent—from 0.84 million tons in 1958 to 1.18 million tons in 1966. During the same period consumption of uncoated book paper increased 56 percent—from 1.24 million tons to 1.93 million tons.

End Uses

Printing papers have five[1] basic applications: catalogs and directories, magazines, books, commercial printing, and converting. In the last 10 years magazines have declined in importance, and books and commercial printing have increased their share of total printing-paper consumption. Comparative data for 1958, 1967, and 1976 are given in Figure 4 and Table 10.

Periodical publishing: magazines, catalogs, and directories. Together, magazines, catalogs, and directories account for almost half of all printing paper consumption. Between 1958 and 1967, the total consumption of printing paper for periodicals increased 40 percent in tonnage. The tonnage of magazine publishing paper alone, however, increased by only 26 percent.

Catalogs and directories, including such items as telephone books, mail-order catalogs, and business and professional directories, are of transitory value to the user and are replaced regularly by up-to-date issues.

Book publishing. In recent years, books have become much more important as a communications medium. Consumption of paper for books increased 70 percent in 8 years—from 0.30 million tons in 1958 to 0.62 million tons in 1967 (Table 10).

This growth has occurred in all areas of book publishing—textbook, fiction, and nonfiction, both hard-cover and soft-cover. The growth is also reflected in the number of new titles, which has been increasing at a rate of about 10 percent annually.

In 1966, 1.2 billion books were sold. Fifty-eight percent of these books were soft-cover; the remainder were hard-cover. A sizable share—29 percent—were textbooks and workbooks. Textbook sales have grown in recent years because of the increasing emphasis on education throughout the country. The average number of textbooks sold per student (including hard- and soft-cover, and workbooks) has increased substantially; the American Textbook Publishers Institute reported per capita figures with average increases of 35 percent to 55 percent during the 1955 to 1966 period (Table 11).

The rise in textbook sales has been accompanied by a rise in general book sales in proportion to increases in disposable personal income. It appears that the adult population is demanding more reading materials for both education and pleasure. General adult book sales (in copies) increased 19 percent from 1963 to 1966; during the same period professional book sales increased 41 percent.

Commercial printing. Commercial printing consumes a large share of the production of coated groundwood and book papers and uncoated book paper. In 1966, commercial printing accounted for 2.0 million tons—more than one-third of total printing paper consumption. In 1959, commercial printing consumed less than half that amount—0.97 million tons (Table 12). Overall, the consumption of paper by commercial printing increased at 7 percent a year in the 1959 to 1967 period.

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[1] Labels and wraps are a sixth type of application for printing paper. However, they have been excluded from this analysis because they were covered in the earlier MRI report, *The Role of Packaging in Solid Waste Management, 1966 to 1976.*

TABLE 9.—*Consumption of newsprint and nonpackaging printing paper grades: 1958–1976**

(In thousands of tons)

SIC	Grade	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1970	1976
2621111	Newsprint†	6,515	7,037	7,312	7,386	7,456	7,577	8,092	8,442	9,093	8,864	9,700	11,400
	Printing papers, total:	3,489	3,880	4,071	4,064	4,249	4,512	4,827	5,219	5,764	5,622	6,615	8,210
26212	Groundwood paper, uncoated, total:	839	927	952	919	920	964	1,009	1,071	1,179	1,123	1,250	1,350
2621223	Groundwood publication and printing paper:	653	739	753	751	762	814	852	911	992	938	1,055	1,150
2621213	Grade A	377	442	430	381	386	407	387	417	450	NA‡	—	—
2621215	Grade B	276	297	323	370	376	407	465	514	542	NA	—	—
2621224	Groundwood converting paper, total:	146	159	176	134	132	123	128	130	150	153	155	160
2621221	Hanging	45	46	43	34	36	29	29	27	31	NA	—	—
2621222	Produced for establishments without paper making equipment	—	—	133	100	96	94	99	103	119	NA	—	—
2621227	Body stock for carbonizing	18	18										
2621228	Other including drawing, tablet, album, etc	83	95										
2621229	Miscellaneous groundwood paper:	40	29	23	34	26	27	29	30	37	32	40	40
2621233	Poster	11	10	—	17	19	16	17	17	21	NA	—	—
2621239	Other miscellaneous	29	19	—	17	7	11	13	13	16	NA	—	—
	Coated printing and converting paper§:												
	Coated two sides	1,414	1,550	1,711	1,852	1,964	2,077	2,262	2,436	2,656	2,644	3,365	4,710
26214	Book paper, uncoated, total§:	1,236	1,403	1,408	1,293	1,365	1,471	1,556	1,712	1,929	1,855	2,000	2,150
2621412	Book publication and printing paper:	969	1,054	1,063	1,048	1,078	1,173	1,234	1,373	1,572	1,514	1,650	2,070
2621414	Plain, including M.F., E.F., antique, etc	288	297	271	247	214	205	190	216	243	—	—	—
2621416	Supercalendered	201	183	161	98	65	69	58	38	41	—	—	—
2621418	Offset	458	551	613	685	776	874	959	1,104	1,270	—	—	—
2621419	Other book printing	22	23	18	18	22	25	27	15	18	—	—	—
2621433	Book converting papers, total§:	257	337	326	239	268	294	318	338	356	340	350	380
2621421	Body stock for coating§	91	114	119	—	—	—	—	15	(45)¶	—	—	—
2621427	Tablet	166	223	207	239	268	294	318	323	311	340	—	—
2621437	Miscellaneous book paper	10	12	19	8	19	4	4	1	(1)¶	(1)¶	—	—

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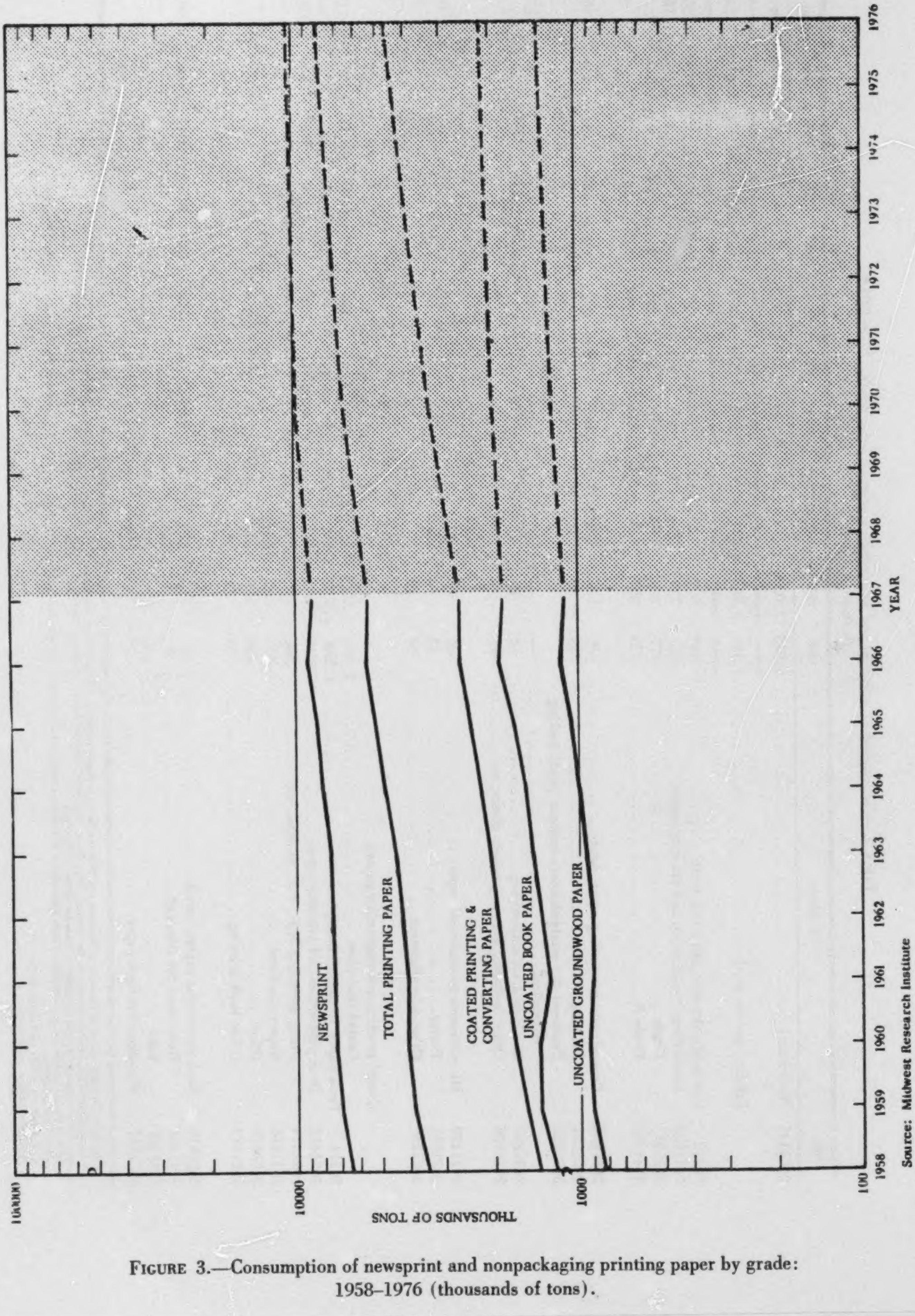
*From: U.S. Department of Commerce, Business and Defense Services Administration, "Pulp, Paper, and Board," *Quarterly Industry Report*. 24(1):23–27, Apr. 1968. U.S. Department of Commerce, Bureau of the Census, Pulp, Paper, and Board, *Current Industrial Reports*. Series M26A(60–13)—M26A(66–13). Washington, 1961–1967. Import/export adjustments and forecasts by Midwest Research Institute.

†For newsprint, apparent consumption equals new supply adjusted for changes in inventory. For all other grades, is apparent consumption production adjusted for imports and exports.

‡NA Not available.

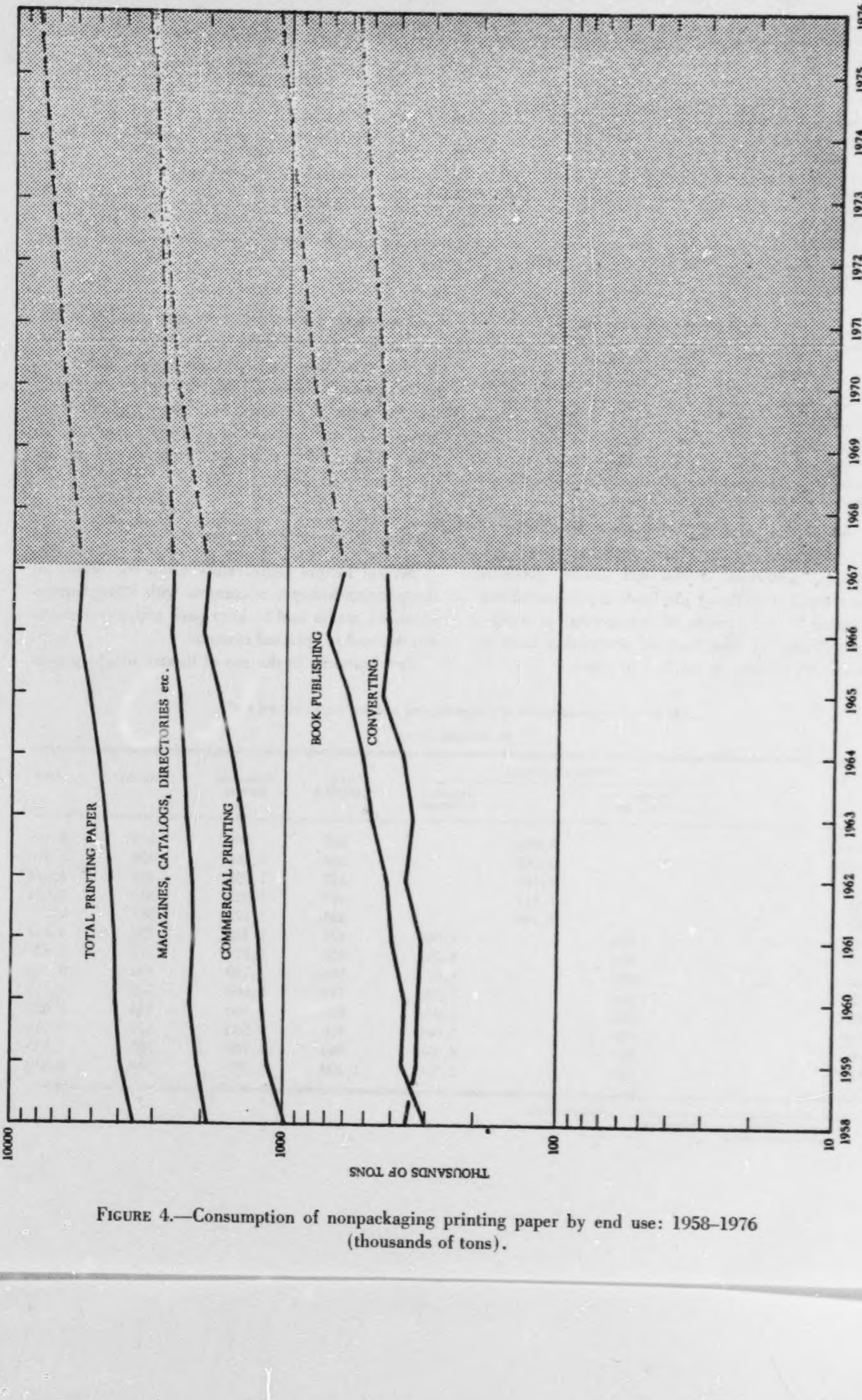
§Adjusted to exclude packaging grades.

¶Estimates are in parenthesis.



Source: Midwest Research Institute

FIGURE 3.—Consumption of newsprint and nonpackaging printing paper by grade: 1958–1976 (thousands of tons).



Source: Midwest Research Institute

FIGURE 4.—Consumption of nonpackaging printing paper by end use: 1958–1976 (thousands of tons).

TABLE 10.—*Comparative data for nonpackaging printing paper by end use: 1958, 1967, and 1976**

(In thousands of tons)

End use	1958 Tonnage	1958 Percent	1967 Tonnage	1967 Percent	1976 Tonnage	1976 Percent
Catalogs, directories	(330)†	9.5	665	11.8	1,000	12.2
Magazine publishing	(1,538)†	44.1	1,944	34.6	2,200	26.8
Book publishing	297	8.5	624	11.1	1,100	13.4
Commercial printing	966	27.7	1,956	34.8	3,330	40.5
Converting‡	358	10.2	433	7.7	580	7.1
Total	3,489	100.0	5,622	100.0	8,210	100.0

*From Midwest Research Institute, based on industry sources.
†Estimates are in parentheses.
‡Excludes packaging grades.

TABLE 11.—*Textbook sales: 1955 and 1966**

School level	Books per student 1955	Books per student 1966	Percent change
Elementary	4.08	5.49	+35
High school	3.28	4.74	+45
College	6.31	9.75	+55

*Source: American Textbook Publishers Institute.

Commercial printing encompasses direct-mail advertising, booklets, brochures, leaflets, reports, promotional materials, forms, and similar products. Direct-mail advertising has made a substantial contribution to the growth of commercial printing—expenditures for that form of advertising have increased 55 percent in the last 10 years.

Converting. Converting is a term used to designate making paper into various products by cutting, folding, trimming, and other processes. Tablets and adding-machine tapes are representative examples of converted paper products. In 1958, converting consumed 0.36 million tons of printing paper, and in 1967, 0.43 million tons—an 8-year change of approximately 18 percent.

Techno-Economic Trends

Several factors significantly affect the ability of the printing industry to compete with other communications media and to keep pace with the increasing demand for printed material.

Developments in the use of lighter weight papers

TABLE 12.—*Consumption of nonpackaging printing paper by end use**

(In thousands of tons)

<table>
<tr><th rowspan="2">Year</th><th colspan="2">Periodical publishing</th><th rowspan="2">Book publishing</th><th rowspan="2">Commercial printing</th><th rowspan="2">Converting†</th><th rowspan="2">Total</th></tr>
<tr><th>Catalogs, directories, etc.</th><th>Magazine publishing</th></tr>
<tr><td>1958</td><td colspan="2">1,868</td><td>297</td><td>966</td><td>358</td><td>3,489</td></tr>
<tr><td>1959</td><td colspan="2">2,040</td><td>368</td><td>1,146</td><td>326</td><td>3,880</td></tr>
<tr><td>1960</td><td colspan="2">2,188</td><td>357</td><td>1,203</td><td>323</td><td>4,071</td></tr>
<tr><td>1961</td><td colspan="2">2,117</td><td>404</td><td>1,228</td><td>315</td><td>4,064</td></tr>
<tr><td>1962</td><td colspan="2">2,140</td><td>425</td><td>1,328</td><td>361</td><td>4,249</td></tr>
<tr><td>1963</td><td>504</td><td>1,765</td><td>478</td><td>1,425</td><td>240</td><td>4,512</td></tr>
<tr><td>1964</td><td>561</td><td>1,791</td><td>526</td><td>1,572</td><td>377</td><td>4,827</td></tr>
<tr><td>1965</td><td>602</td><td>1,828</td><td>596</td><td>1,749</td><td>448</td><td>5,219</td></tr>
<tr><td>1966</td><td>694</td><td>1,938</td><td>710</td><td>2,000</td><td>422</td><td>5,764</td></tr>
<tr><td>1967</td><td>665</td><td>1,944</td><td>624</td><td>1,956</td><td>433</td><td>5,622</td></tr>
<tr><td>1970</td><td>920</td><td>2,030</td><td>810</td><td>2,500</td><td>455</td><td>6,615</td></tr>
<tr><td>1973</td><td>950</td><td>2,050</td><td>940</td><td>2,900</td><td>505</td><td>7,345</td></tr>
<tr><td>1976</td><td>1,000</td><td>2,200</td><td>1,100</td><td>3,330</td><td>580</td><td>8,210</td></tr>
</table>

*From Midwest Research Institute, based on industry sources. Forecasts by Midwest Research Institute.
†Packaging paper omitted.

and coated papers are of particular significance to the role of paper in solid waste.

In recent years lighter basis-weight [2] papers have come into use with the same strength and opacity as heavier weight papers. The present standard weight is in the range of 43- to 45-lb basis weight. Recently, however, a 38-lb stock has been regularly produced and will probably displace the heavier grades. High circulation magazines have been important in bringing about this weight reduction. It is even possible that book and magazine paper weights could fall to 30-lb in the next decade, although there are a number of technical problems, such as lack of strength and surface ability to take an impression, that must be overcome before this paper could be used in volume application. Because of rising postal rates, publishers of periodicials strongly favor progress toward lighter basis-weight paper; thus, a further decline in basis weight can be expected.

The second development, the use of coated papers, will continue to increase in importance. Coated stock is used in commercial printing, better quality magazines, and other publications; its appearance, especially when illustrations are used, is better than that of uncoated stock. Although coating technology is unlikely to influence the total consumption of printing paper in the near future, it is likely that consumption of coated papers will grow at a faster rate than will that of total printing papers.

Other factors that will enable the printing industry to print more rapidly and more efficiently, and thus increase the volume of paper consumed, include the growing use of offset presses, with photomechanical reproduction methods that are adaptable to automation procedures; the application of various electronic, automated, and computerized techniques to layout, makeup, and steps in the printing process; and the development of photocomposition devices for high-speed typesetting.

Periodical publishing has been affected in recent years by competition with other media, especially television, for advertising. Between 1960 and 1967, television's share of total advertising rose from 13.3 to 17.2 percent, while magazine advertising dropped from 7.9 to 7.6 percent of the total.

Two factors make it difficult to relate these figures to changes in paper consumption. Total advertising expenditures may increase every year; therefore, yearly dollar expenditures for magazine advertising may rise while the magazines' percentage of total expenditures falls. Also, because rates per page as well as paper consumption appear in advertising expenditures, a change in expenditures does not necessarily indicate a corresponding change in paper consumption, but may be due to changing rates per page.

Television will probably continue to compete strongly for advertising, moderating or even reducing the paper-consumption increases of magazines in the next few years.

In addition to these changes, there may be several developments in the future that will radically alter the importance of the printed word as a means of communication. In general, these new techniques actually eliminate or greatly reduce the amount of paper printed copy.

Microfilm cards or microfiche may be used to store documents; the microphotograph may be used for reproduction if a copy of the document is needed. The Federal Government is already employing this system for scientific and technical material. Microfilm could also be used for publication of scientific and technical journals.

Authors may sell their works to information systems specialists instead of to publishers; reproduction would be either on microfilm or in hard copy, and royalties would be paid on the basis of the number of times an original is reproduced.

Subscribers may receive facsimile transmission of data (either printed or illustrated) over wire from magnetic tape for production by facsimile translators at their offices. Data that are now received on subscription basis in printed form could be provided on magnetic tape or punch card.

Users may have remote access to data stored in massive computer memory systems. Such data could be retrieved on visual display equipment and reproduced into hard copy if necessary.

Use of display and information retrieval systems may become important. Some businesses with catalog operations are already using these machines for access to large catalogs that must be continually updated, such as those of automotive parts.

These and many other new approaches in information technology may ultimately greatly reduce the volume of paper consumed in the United States. It is unlikely, however, that these approaches will have any significant impact prior to 1976, primarily because of the cost of these systems and their rather specialized application at present. These systems require equipment not generally accessible to everyone in business; the investment cost is quite substantial; and frequently, basic changes in a business operating routine are necessary. Currently these systems are applied primarily to scientific and technical data, and they are not practical at this time for popular publications. In addition, these new systems are unlikely to have any effect on pleasure and entertainment reading.

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[2] Basis weight is the weight in pounds of a given number of designated-size sheets, commonly one ream (500 sheets) of 25- by 38-inch stock.

Thus it appears that the printed word will retain its dominant position as a communications medium during the coming decade, and that printing paper will remain in its secure position as the carrier of the printed word.

Forecast

Based on expected population increases, the rapidly increasing amount of knowledge, the use of more efficient printing techniques, and various other economic, social, and technical factors, the consumption of printing paper is forecast to be 8.21 million tons in 1976. This figure represents a 3.6-percent annual growth rate over the 1966 figure of 5.76 million tons. Comparative data for uncoated groundwood, uncoated book paper, and coated printing paper are given in Table 9 and Figure 3.

In arriving at this forecast, we first considered the various grades of printing paper and their characteristics separately. Figure 4 and Table 12 present summary data for each grade for 1958 through 1976. A brief summary of the forecast for each of the five grades follows:

Periodicals: magazines, catalogs, and directories. Printing paper consumed for this class of publications is expected to increase from 2.63 million tons in 1966 to 3.20 million tons in 1976.[3] By 1976, magazines should consume 2.2 million tons, more than two-thirds of the total; catalogs and directories will account for 1.0 million tons. The forecast assumes that there will be an overall increase in magazine paper consumption. This increase, however, will be largely offset by the use of lighter weight papers, especially by the high-volume magazines (e.g., *Life*) and the impact of advertising competition between media. The use of coated papers should also continue to increase, particularly as color printing becomes more common. Consumption of paper for catalogs should increase at the rate of 4 percent per year, about equal to the GNP rate.

Books. The basic trends of recent years are expected to influence the consumption of paper for books to the mid-1970's. The forecast is for an increase of about 4.5 percent per year, from 0.71 million tons in 1966 to 1.1 million tons in 1976.

Commercial printing. Paper for commercial printing is a definite growth area in printing paper. Between 1959 and 1967, commercial printing paper consumption increased at the rate of 7 percent per year. This growth should continue, although at a slightly slower pace—5.2 percent per year average. By 1976, consumption should be at about 3.3 million tons, compared with 2.0 million tons in 1966.

Converting. There is a fairly stable demand for the products made by converting operations; thus, demand increases at a moderate rate. Consumption is forecast to increase to 0.58 million tons in 1976, an increase of 3.2 percent per year over the 1966 consumption of 0.42 million tons.

FINE PAPER

In 1966, 2.70 million tons of fine paper were consumed. This figure represented 9.9 percent of total nonpackaging paper consumption. In 1958, consumption was 1.51 million tons; the increase in consumption in the 9-year period was an impressive 80 percent.

Fine papers are used primarily for such general business purposes[4] as letters, forms, records, and reproduction, and also for a multitude of specialty applications, such as drawings, maps, and wedding invitations. Fine papers are the backbone of the business world in terms of paper requirements and represent a prime communications medium in day-to-day business and government operations.

Most fine paper is made from chemical pulp and is usually bleached; rag content papers used in specialized applications, such as bond, currency, ledgers, and maps are also classed as fine paper.

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[3] It is also interesting to note that a large percentage of printing paper for periodicals—15 to 18 percent of total tonnage—never reaches the ultimate consumer. This share is lost at various points in the printing process—from outer wrapping of rolls and press waste to bundling losses and trim waste.

[4] In this report "general business" includes all private business and industry, institutional, government, and some personal or consumer uses of paper.

Types of Fine Paper

Fine paper has traditionally been classified in six major groupings: writing paper, bristols, cover paper, text paper, colored school and construction paper, and thin paper.

Writing paper. These grades are by far the most important in tonnage, accounting for 2.08 million tons or 77 percent of total fine paper in 1966 (Table 13). Writing paper may be used for many specialized applications, but it is generally suitable for printing, typewriter, pencil, pen, or ink. The most important properties of writing paper are its surface characteristics, because it is primarily used to communicate or carry information. Writing paper with a rag content serves as a high-quality paper for stationery, bank checks, ledgers, technical papers, and currency.

The most common writing grade is that produced from chemical wood pulp. In 1966, about 1.2 million tons of this paper were used in business forms, letterhead, and general business communications papers, all of which are generally known as bond papers. Much smaller quantities are used for ledgers, manifold (copy), mimeograph, reproduction, maps, charts, and the like.

Writing paper consumption nearly doubled in the 1958 to 1967 period, increasing from 1.18 million tons to 2.04 million tons. This is a growth rate of 6.3 percent per year for the period. The useful life of writing papers varies widely depending on the nature of the document for which it is used. Most business papers have relatively limited value and are disposed of in the same year or kept for only a few years. However, a significant proportion of writing paper is retained permanently or semipermanently by business and government.

Bristols. These papers are the grades used primarily for index cards, file cards, post cards, posters, and similar items.[5] In 1966, 0.17 million tons of bristols were consumed, compared with 0.12 million tons in 1958. Bristols have had a somewhat variable consumption record in recent years, but consumption has been rising along with general economic or business activity. Bristols are a well-established paper grade.

Although most bristols have a typically short useful life, those used for file cards, particularly library file cards, have a very long life. Bristols used for postcards and posters have a very short useful life.

Cover paper. Cover paper is used primarily for high-quality products such as corporate annual reports, brochures, and pamphlets. It is also used extensively as menu stock for restaurants. During the 1958 to 1966 period, consumption varied between 39,000 tons and 56,000 tons per year and thus was a very minor portion of fine paper. Cover paper is used in products of relatively high retention value; the life span is usually between 1 and 4 years.

Text paper. Text paper is a high quality paper used for high grade printing and is typically found in brochures, annual reports, and pamphlets; it is not used in books. The consumption of text paper had an impressive percentage gain in the 1958 to 1966 period, growing from 64,000 tons to 130,000 tons. This was a period in which many types of special publications were upgraded in quality and appearance. In general, text paper has about the same retention value as cover paper.

Colored school and construction paper. This paper is used in schools for scratch and work paper and for craft project work. Although it is classified with fine paper, it is generally a groundwood and thus of somewhat lower quality than are most fine papers. Consumption has varied from 4,000 tons in 1958 to 24,000 tons in 1966, although it ranged between 17,000 and 21,000 tons in most of these years. This type of paper has a very low retention value and is generally discarded quite rapidly, except for a minor portion that might be saved as mementos.

Thin paper. This is a term applied to lightweight paper similar to tissue. It is used for specialized applications such as carbon paper, cigarette paper, copy paper, Bibles, and lens paper. However, about 60 percent (144,000 tons) is used in carbon paper. Cigarette paper accounts for most of the remaining 95,000 tons.

Consumption of thin paper more than doubled in the 1958 to 1966 period—from 103,000 tons to

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[5] A similar type of stock is used for tabulating cards and file folders, but these traditionally have been classified as special industrial paper and are discussed in that section of the report.

TABLE 13.—*Consumption of fine paper grades: 1958–1976**

(In thousands of tons)

SIC	Grade	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1970	1976
26215	Fine paper, total	1,506	1,735	1,747	1,899	2,038	2,086	2,201	2,417	2,697	2,613	3,100	3,800
2621540	Writing paper, total:	1,176	1,343	1,355	1,473	1,560	1,590	1,690	1,872	2,081	2,042	2,435	2,985
2621542	Writing, rag, total:	112	119	115	118	118	119	118	122	133	134	140	150
2621512	Bond and writing including protective check	65	69	66	70	71	70	72	76	85			
2621516	Ledger	11	11	11	11	11	11	10	10	9			
2621518	Onion skin and manifold	6	7	7	7	7	7	7	7	8			
2621522	Papeterie and wedding	2	2	2	3	2	2	2	2	2			
2621524	Direct line or process		3	3	3	3	3	3	4	4			
2621532	Reproduction and similar base stock	17	11	11	9	9	8	7	6	6			
2621526	Other technical papers incl. map		5	5	5	5	6	6	6	7			
2621536	Index	6	7	6	6	6	7	6	6	7			
2621539	Other	5	4	4	4	4	4	5	5	5			
2621552	Writing, chemical wood pulp, total:	1,064	1,224	1,240	1,355	1,442	1,471	1,572	1,750	1,948	1,908	2,295	2,835
2621541	Bond and writing, including protective check	658	747	736	800	872	889	971	1,088	1,196			
2621543	Ledger	41	47	42	43	46	45	43	47	49			
2621545	Manifold	20	26	26	24	23	18	16	20	21			
2621547	Mimeograph—all wood pulp furnish	89	102	102	110	113	115	117	117	132			
2621549	Gelatin and spirit process duplicating	70	76	75	106	112	116	117	126	145			
2621551	Papeterie and wedding	39	50	50	45	49	43	45	45	52			
2621553	Direct line or process papers		51	57	63	68	69	71	76	87			
2621556	Reproduction and similar base stock	73	37	39	39	44	45	51	64	79			
2621555	Other technical, incl. map	12	11	12	22	22	26	26	36	43			
2621557	Opaque circular	22	28	30	29	27	18	21	23	24			
2621559	Other	40	49	71	74	66	87	94	108	120			
2621562	Bristols, total:	120	136	125	134	148	155	154	146	167	152	200	250
2621563	Index (chemical wood pulp)	91	109	99	94	98	98	99	101	115			
2621565	Printing	23	20	19	21	32	43	44	36	42			
2621567	Uncoated post card (commercial)	6	7	7	19	18	14	11	9	10			
2621569	Government post card stock												
2621573	Cover paper	39	43	44	47	47	49	49	55	56	(55)†	55	60
2621575	Text paper	64	71	76	85	91	103	106	120	130	(132)†	145	180

2621578	Colored school and construction paper	4	16	11	18	19	21	18	17	24	(24)†	25	30
2621582	Thin paper, total:	103	126	136	142	173	168	184	207	239	207	240	295
2621581	Carbonizing free from ground wood	59	69	75	78	91	97	106	120	144			
2621583 2621585	Cigarette and condenser	36	43	51	54	82	71	78	87	95			
2621589	Other (stencil, lens)	8	14	10	10								

*From: U.S. Department of Commerce, Business and Defense Services Administration, Pulp, paper, and board, *Quarterly Industry Report*. 24(1):23–27, Apr. 1968. U.S. Department of Commerce, Bureau of the Census, Pulp, Paper, and Board, *Current Industrial Reports*. Series M26A(60–13)—M26A(66–13). Washington, 1961–1967. Import/export adjustments and forecasts by Midwest Research Institute.

†Estimates are in parenthesis.

239,000 tons. During this period, business forms using one-time-use carbon were gaining rapid acceptance; carbon-paper consumption increased 144 percent. By 1967, however, it was evident that this rapid growth was declining, since total thin-paper consumption dropped 32,000 tons to 207,000 tons. For the most part, these papers have a short useful life and are discarded the same year that they are produced. For example, most carbon paper used in business forms is used once and then thrown away.

Techno-Economic Trends

The primary consumers of fine papers, especially the writing grades, are various types of administrative offices in business, industry, government, finance, and a multitude of private and public institutions. Today, fine paper is one of the basic means of transmitting and storing information in the business world. To understand the role of fine paper in future office operations we must look at office-machine systems and information-handling techniques that have been developed and that will directly or indirectly affect the use of fine paper.

Consumption of fine paper increased 80 percent in the 1958 to 1966 period. Much of this growth was in the writing paper grade, which is most commonly used in office operations. Of course, much can be attributed to the vigorous economic activity that occurred during that period. At the same time, however, more paper was used because there was a growing demand for, and supply of information in many fields. The information explosion has created an almost overwhelming increase in the consumption of paper.

To deal with this problem, numerous office systems and a wide variety of machines have been developed. The prime objectives of these systems are to handle information more rapidly, more efficiently, more conveniently, at a lower cost, and in higher volumes. Very few of these systems have as their primary objective the reduction of paper per se; they are just as likely to increase the use of paper as they are to decrease or eliminate it. All of these systems, however, undoubtedly have some effect on the volume of paper consumed. For example, in-house duplicating machines and copying machines have made reproduction of printed material convenient and easy and thus have stimulated the use of paper. Today it is much easier and faster to make copies of a magazine article to distribute to coworkers than it is to route the magazine to all of them.

As entirely new systems and machines have been developing, traditional office machines have been increasing in speed, efficiency, and sheer volume. Machines such as typewriters, adding machines, and calculators all use paper. As the number of these machines increases, so does the amount of paper they consume.

The major developments in office systems and machines that are affecting paper consumption are in: (1) information storage and retrieval; (2) telecommunications; (3) electronic data processing; and (4) office copying and duplicating.

Information storage and retrieval. The office operation was once limited to routine storage techniques—filing and microfilming. Now, however, many advanced techniques—automatic file and retrieval systems, microfilm systems of current information, and storage and retrieval of information in computers—are available. Allied with these techniques are various data acquisition and display techniques that use optical scanning devices, computer hookups, reading and printing devices, and electronic and mechanical aids to locate and then communicate information. These information systems eventually may reduce fine-paper consumption, although probably not significantly prior to 1976.

Telecommunications. In telecommunications, information is transmitted electronically from one location to another location, perhaps many thousands of miles away. At the receiving location, the information may be reproduced for routine handling, or it may enter a data system, such as a computer, for further processing. In some of the systems that are being developed, the centrally stored information can be viewed and used without being transformed into hard copy.

Electronic data processing. Computers consume large quantities of paper in both input and output operations. Input requires tabulating cards (which are discussed in the section on special industrial paper), and output requires large quantities of form-bond or register-bond papers, which are part of the writing paper grade of fine papers.

Register bond accounts for about one-third (400,000 tons) of the total bond writing paper consumed in 1966; 10 years ago, register bond accounted for only a minor fraction of fine paper. It is estimated that today about one-half of the total dollar volume of business forms expenditures is for computer paper.

In computer output there are three trends that may slow the rate of growth of register-bond consumption: (1) use of lightweight papers; (2) reduction of volume and number of copies of printout of routine reports; (3) direct transfer of data from one magnetic tape to another or to memory. There are other developments that may eventually tend to reduce register-bond consumption, although probably not significantly before 1976. These developments include the use of touch-tone telephone equipment to feed data into computers, which eliminates the need for input paper; and direct machine-to-machine input, which eliminates the need for both input and output paper.

Overall, however, the consumption of register bond by computers should continue to increase for some time. The basic impetus behind this increase is the growing number of computer installations, and there are no indications that this growth will slacken. For example, in July 1964 there were 20,300 computer installations; two years later the number of installations had increased by 80 percent to 36,200 installations, and by early 1967, 43,000 computers had been installed, and 25,000 computers were on order. Thus, even if the amount of paper consumed by each computer is reduced significantly, the total volume consumed by all the computers will still be quite substantial. The growth in consumption will continue at least until the mid-1970's for both input and output papers.

Office copying and duplicating. The use of various office copying machines has grown substantially. Total sales of copying machines and related supplies have increased from $445 million in 1964 to an estimated $1 billion in 1968. Of this amount, about 30 percent is spent on supplies, primarily chemically treated fine papers.

In producing copies, copying machines consume vast quantities of paper. In 1965, 500,000 copying machines turned out an estimated 10 billion copies. Today, with 800,000 copiers in operation, it is estimated that annual output is approximately 16 billion copies.

Current trends in copying machines are to relatively inexpensive desk-top copiers, which will make copying even more convenient; and to high-speed, high-volume copiers which, in terms of capability and cost, will compare favorably with present duplicating systems—ditto, mimeograph, and offset.

At present, however, duplicating systems, such as offset printing processes, produce an even higher output—250 billion copies per year—than do copying machines. The new duplicating systems are more adaptable than were earlier ones. It is now economically feasible to use many of the duplicating systems for short runs as well as for the more traditional long runs. For example, many offset duplicating machines now available have enabled offices to produce their short and medium run printing requirements in-house.

The duplicator and copier market should continue to grow at a rate of more than 10 percent per year until 1970. At that time, the effects of microfilm magnetic storage, visual display, and electronic data processing systems could begin to moderate the consumption of paper in duplicators and copiers. However, the change is most likely to be a reduction of the rate of growth rather than of the total volume of fine paper consumed by copying and duplicating machines.

Conclusions. In spite of the many technological advances in information handling, these new systems have had little impact on the historical trend in paper consumption, and their overall effect to date has been minor. The forces of economic growth and the growing complexity of our political and economic systems create powerful stimulants to information needs. These needs can be fulfilled conveniently on paper, even though they may also be handled by electronic impulses. As we have learned to process information more efficiently and more rapidly, we have opened up new sources of information never before available. Therefore we can produce and handle more information than ever before, and our office machine technology is enabling us to do just this. As one filing supply product manager put it during our field contacts: "The greatest defenders of paper work economy and the sources of the paper work explosion are the computer and microfilm industries and the government. The former may reduce the amount of information stored in paper form, but they create reams of printed or photocopy data on request. The government, with its multitude of regulations, forms, and legal requirements endlessly proliferated yearly fuels the paper work explosion. Microfilm and similar devices have had little or no negative effect on our industry, nor do we expect that they will in the foreseeable future."

Analysis of these various developments in office systems and machines leads to three conclusions.

Fine-paper consumption will continue to increase at a rate roughly equal to that of general economic activity or the GNP. At the same time, it is likely that there will be some very important encroachments on fine paper consumption in some types of businesses by the mid-1970's; the most likely are financial institutions, banks, insurance companies, and industries that are heavily dependent on scientific and technical information.

Information storage and retrieval technology will accelerate the rate at which paper is discarded. With the reduction of documents to active microfilm systems or their transfer to magnetic memories, the need to retain paper documents will decline. Thus, the successes of information retrieval systems in the 1960's will lead to their more widespread adoption by business and government in the early 1970's. During this period, the retention cycle for business and government documents in paper form will be shortened; and the rate at which paper is discarded by the users will be accelerated. Shortening of the retention time of documents generated in the normal course of business does not necessarily reduce the volume of fine paper consumption, but it does mean that the paper will enter the waste stream more rapidly.

By 1976, some of the systems that have stimulated fine paper consumption will have been refined in ways that will reduce their appetite for paper. Among these systems are electronic computers that will eliminate or reduce the paper requirements on both the input and output sides; teletransmission of data on a broader scale; information storage and retrieval techniques; and perhaps most significantly, renewed efforts by business and government to streamline information-management techniques. In addition, the markets for in-house printing, copying, and duplicating machines should show signs of maturing within the next decade.

Forecast

As a group, the fine papers should increase in consumption about 3.6 percent per year from 1966 to 1976. This rate of growth would result in consumption of 3.80 million tons in 1976.

Consumption forecasts to 1976 were also made for the six major grades of fine paper. These forecasts are summarized in Table 14 and Figure 5.

TABLE 14.—*Consumption of fine paper: 1966 and 1967**

(In thousands of tons)

Fine paper grade	1966	1976	10-year rate of increase (percent)
Writing, rag content	133	150	1.2
Writing, bond or chemical wood pulp	1,948	2,835	3.8
Bristols	167	250	4.1
Cover paper	56	60	0.7
Text paper	130	180	3.3
Colored school and construction paper	24	30	2.3
Thin paper	239	295	2.1
Total	2,697	3,800	3.5

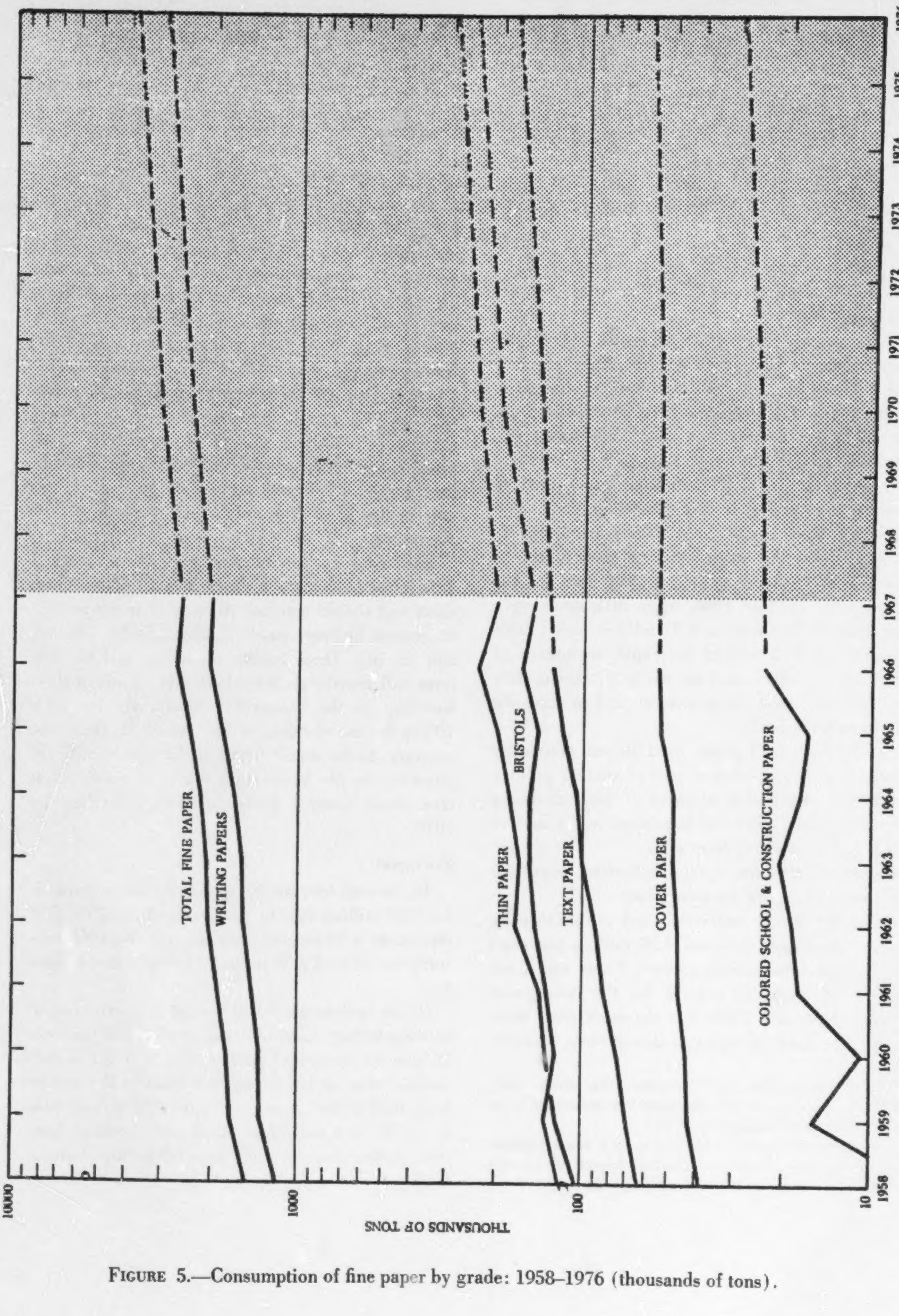
*Source: Midwest Research Institute.

The basis for consumption forecasts for chemical wood pulp writing grades was general economic activity. This paper grade will grow more rapidly in the 1966 to 1970 period than in the 1970-1976 period; the overall growth rate for the 10-year period is forecast at 3.8 percent. For the most part, writing rag, which is a high quality paper, has shown relatively modest growth and the forecast is based on a steady increase of slightly less than 2,000 tons per year in consumption over the next decade.

Bristols are a well established grade, and their rate of growth is forecast to be the same as that of the rate of growth for the GNP—4 percent per year.

The forecasts for cover paper and text paper are based on relatively steady but moderate increases in tonnage consumption—about 2.8 percent per year for the two grades combined. The consumption of colored school and text paper is closely tied to school enrollment. School enrollment in grade schools is not expected to rise nearly as dramatically in the years ahead as it has in the past, because the birth rate has been declining steadily in recent years. Thus we have forecast a moderate increase in consumption of colored school and construction paper to 30,000 tons in 1976—a 2.3-percent growth rate for the 10-year period.

Although the thin paper grades have shown rapid growth in recent years, most of this has been in the



Source: Midwest Research Institute

FIGURE 5.—Consumption of fine paper by grade: 1958–1976 (thousands of tons).

carbon paper stock used for business forms. The outlook for business forms using carbon is very good, but alternative ways of transferring images onto business forms are now available and are beginning to displace conventional carbon paper. Our forecast for thin paper is based on a reduced rate of growth for carbon paper, and the 10-year rate of increase is 2.1 percent.

SPECIAL INDUSTRIAL PAPER

Special industrial paper accounts for only a small share of total nonpackaging paper consumption. In 1966, consumption was 0.92 million tons—3.3 percent of the total.[6]

These papers vary widely in grade and quality from tissue-like filter paper to stiff, heavy abrasive paper. There are three general types of end uses: (1) business, which accounted for 64 percent of the total in 1966; (2) manufacturing, 27 percent; (3) industrial, 10 percent.

The grades of special industrial paper used in business are primarily for file-folder stock and tabulating (tab) card stock.[7] These two business grades, unlike the manufacturing and industrial grades, had a very strong growth rate in the period from 1958 to 1966, more than doubling—from 0.23 million tons to 0.51 million tons (Table 15). This growth reflects the rapid acceptance of the computer, which uses tab cards to transfer data onto magnetic tape for processing and to store the data in memory banks.

Special industrial paper used in manufacturing usually becomes an integral part of another product and is not identifiable as paper. Typical examples are cable paper, electrical insulation and armature paper, and vulcanizing-fiber stock.

Industrial uses for special industrial paper include filter paper and abrasive paper.

Consumption of industrial and manufacturing grades has ranged between 0.28 million tons and 0.31 million tons in recent years. There was a net increase of about 22 percent for the two grades between 1958 and 1966. For the most part, these papers are used in mature, slow-growth markets. The most significant factor influencing their growth appears to be the level of economic activity or industrial production. The effects can be seen in the low consumption in 1958, a recession year, and in the high consumption in 1966, a boom year. In both cases, consumption differed noticeably from the overall trend.

Techno-Economic Trends

The one factor that will be of most influence in the consumption of special industrial paper is changing computer technology. Tab cards, which are used in computers and which account for a sizable portion of total special industrial paper, will be used less frequently as computer technology advances. Most of the new computers that will be put into operation in the 1970's will bypass the tab card. Instead, data will be transmitted directly to magnetic tape by optical character recognition (OCR), paper tape or other approaches to direct input. Thus, consumption of tab card stock is expected to peak at about 0.60 million tons by 1970. It should stay at that level with only minor fluctuations for some time.

File-folder stock is a mature but growing market. It is, of course, routinely used in most office operations and should continue to be used in proportion to general business papers—letters, forms, reports, and the like. These traditional record and file systems will remain an important part of information handling in the foreseeable future. By the mid-1970's the use of miniaturized records or electronic memory banks could begin to have a significant effect on the file folder stock, but it is unlikely that they could cause a decline or even a leveling by 1976.

Forecast

The overall forecast for special industrial paper is for 1.09 million tons to be consumed in 1976. This represents a 19-percent increase over the 1966 consumption of 0.92 million tons (Table 15 and Figure 6).

Of the various grades of special industrial paper, manufacturing and industrial grades will increase 20 percent, from 0.33 million tons in 1966 to 0.40 million tons in 1976; tab-card stock will increase from 0.51 million tons in 1966 to 0.60 million tons in 1976; and file folder stock will increase from 0.07 million tons in 1966 to 0.08 million tons in 1976.

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[6] These consumption data exclude tag stock (SIC 2621715), whose impact on solid waste was considered in an earlier study on packaging materials.

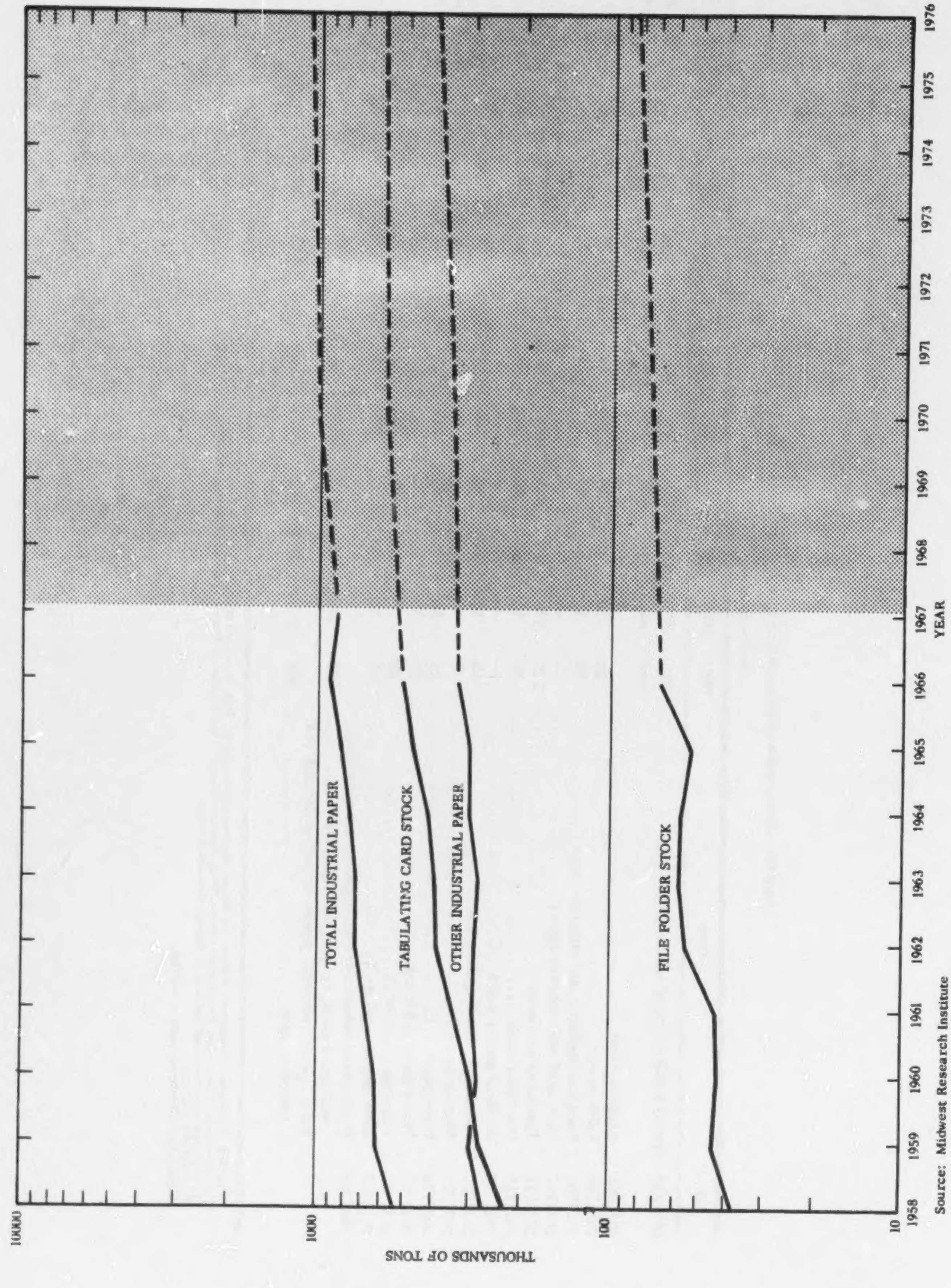
[7] Census reports now give file folder stock and tabulating card stock a new definition: bleached bristols which also includes those items in SIC 261562 under fine paper.

TABLE 15.—*Consumption of nonpackaging special industrial paper grades: 1958–1976**

(In thousands of tons)

SIC	Grade	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1970	1976
2621759	Special industrial paper (all weights):	531	622	622	681	741	738	783	838	916	874	1,025	1,085
2621701	Abrasive paper	7	8	7	7	7	7	8	6	7	—	—	—
2621703	Cable paper	18	18	18	16	15	14	16	16	15	—	—	—
2621705	Electrical insulation and armature paper	10	14	15	20	20	20	21	22	23	—	—	—
2621707	Shot, shell and explosive paper†	—	—	—	—	—	—	—	—	—	—	—	—
2621711	Tabulating card stock	225	279	298	343	394	396	419	479	514	—	600	600
2621713	File folder stock	38	45	43	44	56	59	58	54	69	—	75	85
2621717	Artificial leather base†	—	—	—	—	—	—	—	—	—	—	—	—
2621721	Pressboard, including imitation	15	16	16	18	18	18	17	18	(18)	—	—	—
2621723	Blotting paper	7	7	7	6	5	4	5	5	5	—	—	—
2621725	Filter paper	14	16	15	16	21	18	20	21	23	—	—	—
2621727	Matrix paper and board	10	10	10	10	10	10	11	11	11	—	—	—
2621731	Vulcanizing fiber stock	20	28	26	25	25	27	28	30	33	—	—	—
2621735	Resin-impregnated stock	48	43	38	59	55	61	82	100	98	—	—	—
2621769	Other special industrial including gasket, stencil backing, wallet and patch, tympan, die wiping stock, etc	119	138	129	117	115	104	98	76	100	—	—	—
	Total, special industrial papers excluding tab-card and file folder stock	268	298	281	294	291	283	306	305	333	—	350	400

*From U.S. Department of Commerce, Business and Defense Services Administration, "Pulp, Paper, and Board," *Quarterly Industry Report*, 24(1):23–27, April 1968.
U.S. Department of Commerce, Bureau of the Census, "Pulp, Paper, and Board," *Current Industrial Reports*, Series M26A(60–13)—M26A(66–13). Washington, D.C., 1961–1967.
Import/export adjustments and forecasts by Midwest Research Institute.
†Included with 2621769.
Import/export adjustments made in 2621769.



Source: Midwest Research Institute

FIGURE 6.—Consumption of nonpackaging special industrial paper by grade: 1958–1976 (thousands of tons).

TABLE 16.—*Consumption of nonpackaging tissue-stock grades: 1958–1976**

(In thousands of tons)

SIC	Grade	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1970	1976
26218	Sanitary tissue stock, total:	1,700	1,855	1,939	2,061	2,161	2,319	2,483	2,614	2,825	2,902	3,480	4,670
2621811	Sanitary napkin stock wadding	40	40	(41)†	(41)†	(41)†	(40)†	(38)†	(36)†	34	(34)†	35	40
2621812	Toweling stock (industrial and household)	414	466	515	560	606	664	729	815	896	960	1,165	1,720
2621832	Toilet tissue stock:	777	867	869	927	975	1,043	1,095	1,108	1,184	1,147	1,390	1,700
2621831	Regular type—single ply	520	600	578	626	643	660	650	656	706	—	—	—
2621834	Facial tissue type—two or more ply	257	267	291	301	332	383	445	452	478	—	—	—
2621842	Napkin stock (industrial and resale):	212	229	237	246	249	261	267	285	312	334	375	465
2621841	Regular type—single ply	156	175	179	186	184	194	203	213	235	—	—	—
2621844	Facial tissue type—two or more ply	56	54	58	60	65	67	64	72	77	—	—	—
2621851	Facial tissue stock (except as elsewhere specified)	231	228	248	259	256	272	317	325	332	354	400	480
2621857	Wiper stock (regular facial and wadding type)	21	22	24	23	29	30	33	37	45	(49)†	55	65
2621859	Other sanitary tissue stock	5	5	(5)†	(5)†	(5)†	(9)†	(4)†	(8)†	22	(24)†	60	200

*From U.S. Department of Commerce, Business and Defense Services Administration, "Pulp, Paper, and Board," *Quarterly Industry Report*, 24(1):23–27, April 1968. U.S. Department of Commerce, Bureau of the Census, "Pulp, Paper, and Board," *Current Industrial Reports*, Series M26A(60–13)—M26A(66–13). Washington, D.C., 1961–1967. Import/export adjustments and forecasts by Midwest Research Institute.

†Estimates are in parentheses.

SANITARY TISSUE

In volume, sanitary tissue is the third most important paper group. In 1966, sanitary tissue constituted 10.3 percent of nonpackaging paper, or 2.82 million tons. Consumption in 1958 was 1.7 million tons; thus sanitary tissue experienced a 6.6-percent annual growth rate in the 1958 to 1966 period. During this same period, consumption in lb per capita gained 48 percent, from 19.5 lb in 1958 to 28.7 lb in 1966 (Table 16).

Sanitary tissue is used almost exclusively for personal products. It has much the same application in commercial and industrial establishments as in the home despite long-standing marketing distinctions as between the two classes of outlets which originally had some basis in product differences.

For the most part, tissue products are designed to be used once and then discarded by the user. Their absorbency and soft or gauzy texture distinguish them from other paper grades. They are also generally of light weight, usually lighter than 18 lb.[8] Tissue products become solid waste almost immediately after purchase. There are seven general use categories of sanitary tissue: sanitary napkin stock wadding, toweling stock, toilet tissue stock, table napkin stock, facial tissue stock, wiper stock, and other sanitary tissue stock. Four of these are by far of the greatest importance on the basis of tonnage—toweling, toilet tissue, table napkin, and facial tissue stock. All four of these grades have had substantial increases in consumption in recent years. In fact, tissue has been one of the most vigorously growing paper grades, and may become even more important in years ahead.

Companies producing tissue and tissue products are perhaps the most market conscious group in the paper industry, because they often reach the consumer directly. Tissue products are made to be used by individuals, and the paper itself performs a specific functional use for hygiene, absorbency, and so forth. Thus the individual is made directly aware of the qualities of the product, and brand names are important (e.g., Kleenex). Consumer awareness of the quality of the paper is not as important with many other paper products (e.g., books, magazines) where the function of the paper is to carry a message or act as component of a product. Because the consumer is important, tissue manufacturers are especially attuned to consumer demand changes that have resulted from rising income, increasing emphasis on personal hygiene, and the growing desire for convenient throw-away products. Tissue manufacturers have served rapidly growing markets for towels, napkins, facial tissue, and even toilet tissue in recent years.

Major Types of Sanitary Tissue

Toweling. The consumption of toweling stock increased from 0.41 million tons in 1958 to 0.90 million tons in 1966, an increase of 117 percent. This is a compound growth rate of 10.2 percent per year. Industrial toweling is included in these figures, but the greatest growth and volume come from consumer towel products for home use. Per capita consumption increased from 4.7 lb in 1958 to 9.7 lb in 1967.

Paper toweling has been the fastest growing major end use for tissue paper. It accounted for 31.7 percent of tissue in 1966, up from 24.3 percent in 1958, and is the second most important end use for sanitary tissue. This growth is largely a reflection of what the paper industry has recognized as the "disposable era." Product improvement and upgrading of the image and performance characteristics of paper towels have made them a "necessity" in many households. Manufacturers have introduced new style and color into paper towels in addition to improving their strength and absorbency. For the housewife, paper towels are a welcome replacement to textiles for the many clean-up chores around the house, especially in the kitchen.

Indications are that the markets for toweling are not yet near maturity, and the years ahead will show continued strong growth. Despite its long history of availability to consumers, toweling has only recently become a necessity in the average household. Continued upgrading of the quality of toweling and new uses should add to total consumer demand.

Toilet tissue. Toilet tissue is declining in relative importance to total sanitary tissue, but it is still the largest use and has been for years. One of the interesting facts that become apparent on examination of the historical data on toilet paper is that toilet tissue is a growth market not limited by population increases. Consumption of toilet tissue in 1966 was 1.18 million tons, or 41.9 percent of total tissue. This figure compares with 0.78 million tons in 1958—a 52-percent increase in consumption for the 8-year period. During this period, population increased only 13 percent. On a per capita basis, consumption was 8.8 lb in 1958 and 12.0 lb in 1966.

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[8] Basis weight of 24- by 36-inch stock, 500 sheets.

The explanation for this relatively rapid increase in consumption can be found in consumer acceptance of a product upgraded in quality. Facial tissue type (two-ply or more) accounted for 33 percent of toilet tissue tonnage in 1958 and 40 percent in 1966. Apparently consumers' use-characteristics do not change appreciably as they upgrade to two-ply tissues so that two-ply tissue increases consumption because there is more paper per unit. There has also been a trend toward softer finishes in recent years.

These basic factors should continue to be at work in the years ahead, although there will probably be a definite slowing in the rising per capita consumption of toilet tissue. As the adoption of multiply tissues reaches market saturation, consumption increases will begin to parallel more closely the basic population growth.

Table napkins. The consumption of table napkin stock was 0.31 million tons in 1966 (11.0 percent of total tissue), up 47 percent from the 0.21 million tons consumed in 1958. This is a growth rate of 5.0 percent for the 8-year period. Both industrial napkins for business and commercial use and consumer (retail) napkins are included here, the major volume being in household table napkins.

Paper napkins have been an important factor in tissue production for some time, and they are a well established product. Since 1964, the consumption of the facial tissue type (two-ply or more) has increased about 20 percent, indicating that upgraded product lines may be receiving some consumer attention. Leisure living and home entertainment are also factors of increasing importance in the demand for higher quality table disposables of all types. Coordinated sets of paper napkins, table cloths, and place mats have been marketed with increasing success, but about 75 percent of napkin stock consumption is still in single-ply regular types (Table 16), about the same as in 1958.

The market for tissue disposables is relatively mature, and the years ahead are likely to show only moderate growth in tissue consumption. Some upgrading in quality and appearance can be expected—larger sizes, multi-ply napkins, and softer texture for general use—but increases in per capita consumption will come more slowly than in the recent past.

Facial tissue. The consumption of facial tissue accounted for 11.7 percent of total tissue in 1966. On a tonnage basis, facial tissue consumption was 0.33 million tons in 1966, up 43 percent from the 0.23 million tons consumed in 1958. This is a growth rate of 4.6 percent per year. Consumption has grown in recent years from 2.6 lb per capita in 1958 to 3.4 lb in 1966.

Facial tissue is one of the most familiar and well-established tissue products. Consumers are increasing their use of facial tissues with rising awareness of the convenience of use and easy disposal of the tissues. Manufacturers have concentrated on upgrading the status of facial tissues by offering special decorative colors, attractive dispensers, and a variety of quantities per package and sizes.

In general, facial tissue serves well-established, mature markets. Per capita consumption is unlikely to rise rapidly in the years ahead, although facial tissue paper growth can be expected to outpace the population increase.

Techno-Economic Trends

One of the factors underlying the "disposable era" is the growth of the Nation's economy. Basic to this growth [illegible] a rising per capita disposable income with which to purchase convenience products. Consumer demand for these products arises from scarcity and high cost of home service labor, increased leisure time for adults, informal living habits, the cost and trouble of laundering textile products used as sanitary wipers (e.g., kitchen towels, napkins, handkerchiefs), and a pronounced effort by affluent persons to seek the convenience of throw-away products for home and personal cleaning, and sanitation and hygienic care. Paper makers have responded to consumers' demands with faster and more efficient tissue-production machines and new equipment to keep unit costs down and with marketing programs that encourage new uses for tissue products as well as the acceptance of more tissue per unit. Paper technology is also yielding products that are within the cost ranges that consumers are willing to stronger, more absorbent, and more specialized, yet pay for upgraded, new, or substitute products made of tissue.

The basic forces at work are expected to stimulate the consumption of tissue grades of paper in years ahead, and consumption increases averaging 5 to 7 percent per year for tissue are expected. Thus tissue products will be a much more important factor in solid waste than they have been in the past, and their importance will increase in relation to other paper grades as tonnage consumption outpaces the growth of most other major groups.

One example of a market that may soon consume increasing quantities of tissue paper is baby diapers. This market is large; it is estimated that there are 20 billion diaper changes every year in the United States. Although disposable diapers have been available in the past, they were used primarily for traveling and on other occasions away from home. In addition, they were considered unsatisfactory for several reasons. The new disposable diapers now available have a higher absorbency and can truly be flushed away, at least in part. These new diapers may reach the everyday-use market that manufacturers have long sought; if they do, consumption of tissue, wood pulp, and other materials will increase substantially in the years ahead.[9] In addition to disposable diapers, there are, of course, a host of other new applications available to home, industrial, and institutional markets—hand towels, chemically treated polish cloths, mats, table linens, and the like.

Forecast

Sanitary tissue will continue to grow at a relatively high rate in the period between 1966 and 1976. Our forecasts are based on a per capita consumption of 42 lb in 1976 compared with 28.7 lb per capita in 1966. This is a per capita increase of about 1.3 lb per year, which is near the rate of growth during the 1958 to 1966 period. Total consumption in 1976 will be 4.67 million tons, which is a compound growth rate of 5.1 percent per year for the entire sanitary-tissue group. The forecasts for the individual end-use categories are given in Figure 7 and summarized in Table 17.

TABLE 17.—*Consumption of sanitary tissue: 1966 and 1976**

(In thousands of tons)

End-use category	1966	1976	10-year rate of increase (percent)
Sanitary napkin stock wadding	34	40	1.6
Toweling stock	896	1,720	6.7
Toilet tissue stock	1,184	1,700	3.7
Napkin stock	312	465	4.1
Facial tissue	332	480	3.8
Wiper stock	45	65	3.8
Other sanitary tissue	22	200	25.0
Total	2,825	4,670	5.2

*Source: Midwest Research Institute.

The forecasts for sanitary napkin stock wadding and wiper stock are based primarily on historical trends and consumption increases averaging about 2.5 tons per year.

The high rate of growth in the other category appears because new markets for tissue which do not now have separate end-use categories, but which are expected to grow rapidly in the years ahead are included here. This category includes such products as baby diapers, other personal products, institutional disposables, chemically treated wipers, and so forth.

Toweling is expected to show the highest growth rate for a major end-use category, but the forecast anticipates a declining growth rate as consumption rises above one million tons annually. On a per capita basis, toweling will increase from 9 lb in 1966 to 15 lb in 1976.

The forecast for toilet tissue is based on a rising per capita consumption and further shifts to two-ply tissues. The increase will be from 12 lb per capita in 1966 to 15 lb per capita in 1976. Tonnage increases will be about 50,000 tons per year, nearly the same change experienced in the 1958 to 1966 period.

Both table napkin and facial issue stocks are expected to add about 1 lb per capita to consumption by 1976 above the 1966 level of 3.2 lb for table napkins and 3.4 lb for facial tissue. On a tonnage basis, each is expected to add about 15,000 tons per year, which is slightly above the increase experienced in the 1958 to 1966 period.

If consumers and institutions turn even more strongly toward the use of throw-away tissue prod-

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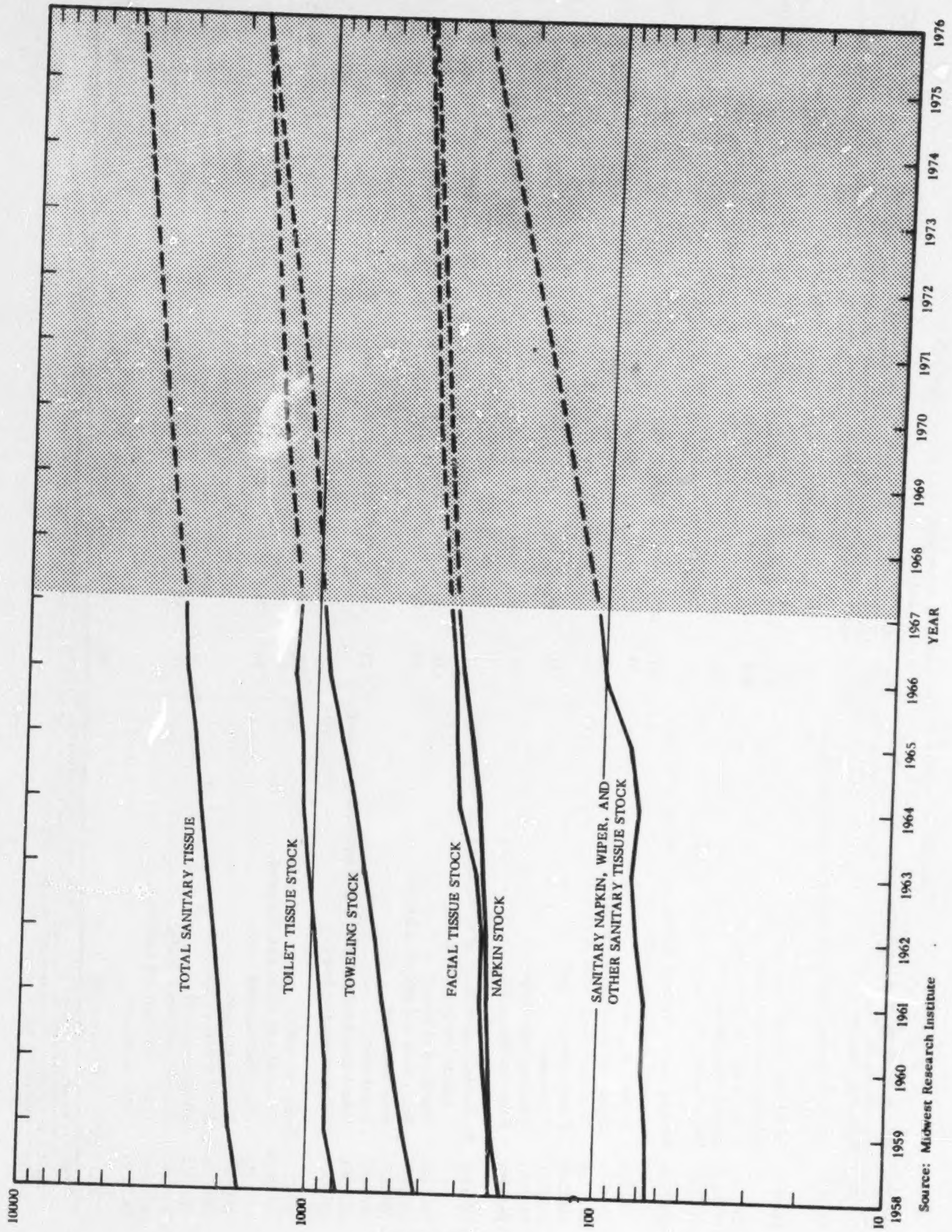
[9] Nontextile diapers are commonly made of a combination of materials, only one of which is tissue; other components are macerated wood pulp, nonwoven textiles, and plastic film. Thus these comments are equally applicable to nonwoven disposables, and disposable diapers are not a tissue product in the same sense that napkins are.



Source: Midwest Research Institute

FIGURE 7.—Consumption of nonpackaging sanitary tissue by grade: 1958–1976 (thousands of tons).

TABLE 18.—*Consumption of nonpackaging special paperboard grades: 1958–1976**

(In thousands of tons)

SIC	Grade	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1970	1976
26315	Special paperboard, total:	1,339	1,478	1,500	1,659	1,560	1,647	1,691	1,864	1,903	1,856	2,115	2,550
2631518	Solid groundwood pulp board, including match-board splint stock	46	34	31	34	38	38	39	40	38	(37)†	40	40
2631519	Panelboard, except wet machine	24	21	(25)†	27	31	29	43	50	44	(44)†	45	50
	Building board stock, total:	670	744	722	698	772	804	816	811	765	(700)†	800	950
2631521	Liner for gypsum plaster board	619	677	644	644	714	742	745	735	686			
2631523	Laminated wallboard stock	51	67	78	54	58	62	71	76	79			
2631529	Other building-board stock												
2631551	Bending board other than folding boxboard, and other than special food board, total:	151	183	192	222	205	195	183	189	203	(232)	220	250
2631552	Unlined chipboard	24	29	36	47	26	25	30	29	37			
2631554	Single and double lined manila chipboard	51	58	60	98	107	92	76	86	89			
2631556	Single and double lined chipboard												
2631558	Patent-coated, all types	41	45	53	21	24	32	35	32	32			
2631561	Clay-coated												
2631565	Other machine coated												
2631569	Other bending board	35	51	43	56	48	46	42	42	45			
2631598	Nonbending other than set-up boxboard and other than special food board, total:	250	263	292	410	307	345	365	381	433	480	500	640
2631571	Newslined chipboard	115	120	133	163	111	106	107	115	137			
2631573	Other lined and unlined chipboard	64	71	74	94	102	125	136	133	150			
2631575	Solid newsboard	71	72	85	153	94	114	122	132	145			
2631577	Strawboard												
2631581	Pasted news-lined and other pasted nonbending boxboard												
2631589	Other nonbending board												
2631531	Cardboard, total:	102	100	114	128	93	102	121	100	103	65	110	120
2631532	Uncoated mill blanks and claycoated	39	37	36	46	38	49	64	55	62			
2631534	Claycoated tag stock												
2631536	Photomount stock	63	63	78	82	55	53	56	45	41			
2631538	Bogus bristol												
2631541	Playing-card stock												
2631543	Railroad and poster manila												
2631545	Coated bristol or post card stock												
2631549	Other cardboard												
2631595	Other special paperboard, total	96	133	124	140	114	134	124	293	317	(297)†	400	500

*From U.S. Department of Commerce, Business and Defense Services Administration, "Pulp, Paper, and Board," *Quarterly Industry Report*, 24(1):23–27, April 1968.
U.S. Department of Commerce, Bureau of the Census, "Pulp, Paper, and Board," *Current Industrial Reports*, Series M26A(6–13)—M26A(66–13). Washington, D.C., 1961–1967.
Import/export adjustments and forecasts by Midwest Research Institute.
†Estimates are in parentheses.

ucts than is now anticipated, some of these forecasts could prove to be conservative.

SPECIAL PAPERBOARD

In 1966, special paperboard consumption was 1.90 million tons, or 7 percent of total nonpackaging paper consumption, compared with 1.34 million tons in 1958. Detail consumption data are given in Table 18.

Special paperboard is used in a great variety of products, from book matches with a short life span to liner paper used in gypsum plaster board in building construction.

There are seven major categories of special paperboard:

(1) Solid ground wood pulp board is used primarily for book matches.

(2) Panelboard is used in the automobile industry for door panels, seatbacks, glove compartments, and the like. Panelboard thus becomes a part of a manufactured product and is not identifiable separately.

(3) Building board stock is used as a liner for building materials such as gypsum board and wall board. About 90 percent is used in gypsum board. Because building board stock is part of another product, it enters the solid waste stream as an insignificant portion of building rubble.

(4) Bending board (nonpackaging) is used for sign boards, display cards, luggage, and book covers.

(5) Nonbending board (nonpackaging) is heavier than bending board and is used for items that require stiffness and relatively rigid construction—hard-cover books, ledgers, toys, jigsaw puzzles, displays, platforms, and so forth.

(6) Cardboard is used in many of the same applications as bending board and also in photomount, playing cards, posters, and simliar products.

(7) Other special paperboard is used in both industrial and office applications. This category includes such diverse items as "red wallet" file folders and machinery gaskets.

Techno-Economic Trends

In general, special paperboard is used in relatively mature markets that are not changing rapidly. The effects of technology are, for the most part, indirect and appear to have only a minor influence on the overall consumption of special paperboard. For certain of the special paperboard grades, such factors as the levels of economic growth or construction activity may have more immediate impact. The demand for panelboard, for example, varies with automobile production and automobile styling.

Building board stock demand, of course, varies with construction activity, particularly home building. In addition, building board stock may not grow as fast as construction activity because it is in competition with dry wall, concrete block, masonry, and wood paneling; these materials are reducing the share of the market enjoyed by building-board stock. It appears that consumption of nonbending board will increase at about the same rate as the GNP increases.

Forecast

It does not appear likely that there will be any factors that will cause significant changes in special paperboard consumption. Thus special paperboard consumption will increase at about 3 percent per year during the 1966 to 1976 period, the same as during the 1959 to 1967 period. Consumption was 1.86 million tons in 1966 and should reach 2.55 million tons in 1976. (See Figure 8 and Table 19 for comparative data on each of the special paperboard grades.)

This forecast is based on individual forecasts for each of the seven grades of special paperboard as summarized in Table 19.

WET MACHINE BOARD

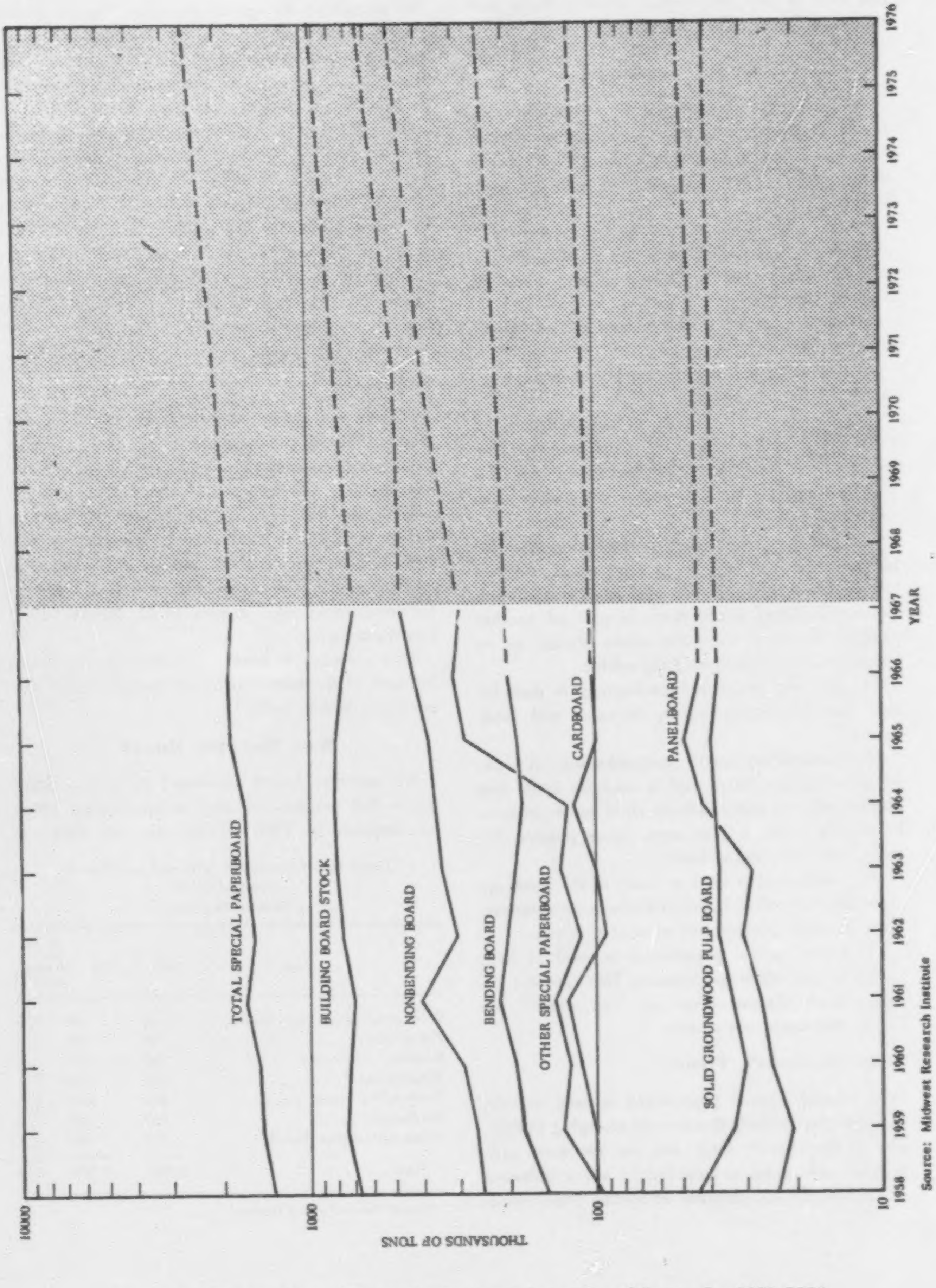
Wet machine board accounted for a very small share—0.6 percent—of total nonpackaging paper consumption in 1966 (Table 20). Its uses are

TABLE 19.—*Consumption of special paperboard: 1966 and 1976**

(In thousands of tons)

Grade	1966	1976	10-year rate of increase (percent)
Solid groundwood pulp board	38	40	0.5
Panelboard	44	50	1.2
Building board stock	765	950	2.2
Bending board	203	250	2.1
Nonbending board	433	640	4.0
Cardboards	103	120	1.5
Other special paperboard	317	500	4.7
Total	1,903	2,550	3.0

*Source: Midwest Research Institute.



Source: Midwest Research Institute

FIGURE 8.—Consumption of nonpackaging special paperboard by grade: 1958–1976 (thousands of tons).

TABLE 20.—*Consumption of wet machine board, construction paper and construction board by grades: 1958–1976**

(In thousands of tons)

SIC	Grade	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1970	1976
26316	Wet machine board, total:	121	147	177	155	147	140	153	150	156	138	160	180
2631614	Binders board	44	50	53	54	58	55	59	59	65	NA	70	80
2631617	Shoe board	53	57	59	59	61	58	61	60	59	NA	60	65
2631619	Other wet machine board	24	40	65	42	26	27	33	31	32	NA	30	35
	Construction paper and board, total:	3,104	3,458	3,267	3,310	3,499	3,703	3,981	4,133	3,967	3,821	4,650	5,650
	Construction paper, total:	1,379	1,441	1,397	1,376	1,419	1,449	1,527	1,575	1,505	1,601	1,650	1,820
	Felts, saturating and dry:												
2661221	Sheathing paper	73	85	58	14	23	27	26	31	30			
2661222	Roofing felts	1,089	1,125	1,120	1,125	1,157	1,175	1,249	1,283	1,215			
2661224	Floor covering	113	117	103	101	101	101	102	102	103			
2661226	Automotive felts	22	30	35	31	33	35	29	34	29			
2661229	Other felts	15	14	12	13	(15)†	22	24	25	29			
2661231	Asbestos paper and asbestos filled	67	70	69	59	60	62	69	73				
2661235	Flexible wood fiber insulation‡									99			
2661239	Other building paper				36	(30)†	27	29	27				
	Insulating and hard pressed board, total:	1,725	2,017	1,870	1,934	2,080	2,254	2,454	2,558	2,462	2,220	3,000	3,830
2661112	Insulating board	1,052	1,172	1,096	1,074	1,078	1,142	1,238	1,258	1,226	NA	1,350	1,580
2499611	Hard pressed board	673	845	774	860	1,002	1,112	1,216	1,300	1,236	NA	1,650	2,250

*From U.S. Department of Commerce, Business and Defense Services Administration, "Pulp, Paper, and Board," *Quarterly Industry Report*, 24(1):23–27, April 1968.
U.S. Department of Commerce, Bureau of the Census, "Pulp, Paper, and Board," *Current Industrial Reports*, Series M26A(60–13)—M26A(66–13). Washington, D.C., 1961–1967.
Import/export adjustments and forecasts by Midwest Research Institute.

†Estimates are in parentheses.

‡Included in 2661221 for 1958–1960.

fairly specialized. Typical uses for wet machine board are binder's board for book binding; shoe board for shoe components such as innersoles, middle-soles, and heels; electrical-press board; coasters; gaskets; and other products. Wet machine board is built up by layering pulp into a thick paperboard.

Because wet machine board is usually combined with other materials and becomes a hidden part of some other product with a fairly long lifespan, it is of relatively minor importance in the generation of solid waste.

Techno-Economic Trends

Wet machine board has experienced a relatively stable market in recent years. Although paperboard produced on faster machines has captured many of the potential markets for wet machine board, it should remain an important material in the markets it now serves.

Forecast

Based on well established trends and the stability of the wet machine board markets, consumption is forecast to increase approximately 15 percent in the 10-year period—from 156,000 tons in 1966 to 180,000 tons in 1976.

CONSTRUCTION PAPER

Construction paper at 1.50 million tons constituted 5.5 percent of nonpackaging paper consumption in 1966. In 1958, consumption was 1.38 million tons, so the net gain in the 8-year period was only 120,000 tons (Table 20). This gain amounted to a less than 9-percent increase—a growth rate of only 1.7 percent per year.

Construction paper or building paper is used predominantly in general building construction. These papers are produced from strong fibers such as rags, wool, and unbleached kraft, as well as waste paper. They generally go through a converting step in which they are coated or impregnated with asphalt or tar. Construction paper is typically used for roofing, sheathing, vapor barrier, and floor covering; a small amount is also used in car trunks and floors. The most important use of construction paper is for roofing papers, which constitute over 80 percent of the total construction paper tonnage consumed.

Although some construction paper becomes waste during the construction process, the overwhelming quantity becomes an integral part of a permanent structure. Thus, its impact on paper waste is very minor; most construction paper waste is part of general building rubble that results from the razing or remodeling of the structures. Only that portion of construction paper that is estimated to be a part of construction waste is included as identifiable paper waste in our analysis.

Techno-Economic Trends

The consumption of building paper does not correlate well with construction expenditures or housing starts. This fact may be partly the result of the increasing proportion of multiple-family dwellings that are being built. Such dwellings tend to reduce the average roof area per unit and thus the need for roofing papers per unit. Single unit structures accounted for 81 percent of total private housing units (including farm) in 1959, but had declined to 65 percent by 1967.

Use of roofing felts has also declined in recent years because of the increasing popularity and use of wood shingles.

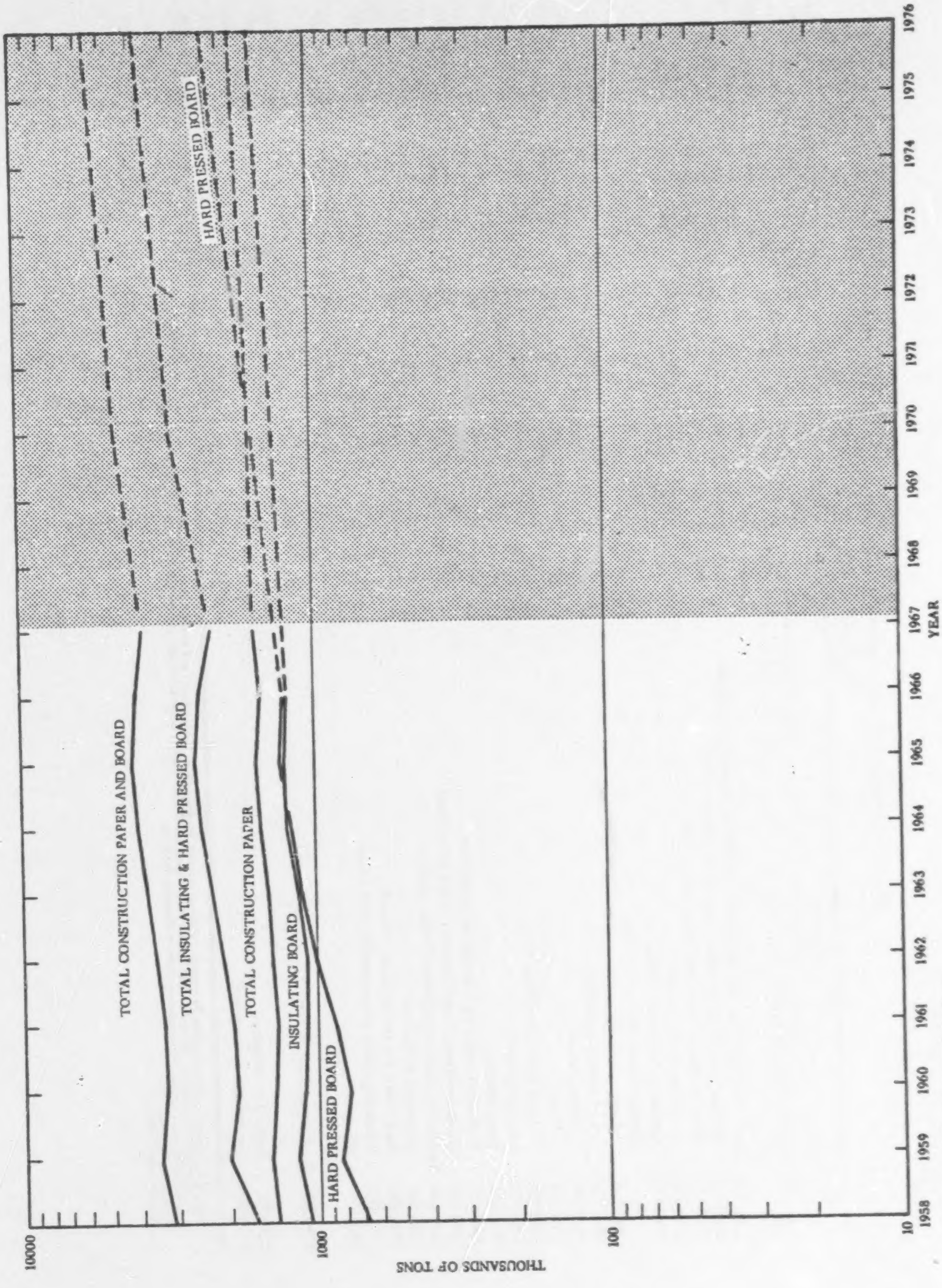
Forecast

The historical trend in consumption was used as the basis for the 1976 consumption forecasts, and it was judged that total demand would continue to rise moderately in the years ahead (Figure 9). The forecast for 1976 is 1.82 million tons, or a growth rate of 2.0 percent per year over 1966.

CONSTRUCTION BOARD: INSULATING AND HARD PRESSED BOARD

At 2.46 million tons, construction board constituted 9.0 percent of nonpackaging paper consumption in 1966. In 1958, consumption was 1.72 million tons, so that total consumption increased 43 percent in the 8-year period. In tonnage, construction board is roughly equivalent to fine paper and sanitary tissue in importance.

Construction board is generally classified into two distinct categories based on density. The lighter boards (approximately 26 or less lb/cu ft) are classified as insulating board; heavier boards (from 26 to 50 lb/cu ft) are classified as hard pressed



Source: Midwest Research Institute

FIGURE 9.—Consumption of construction paper and board by grade: 1958–1976 (thousands of tons).

TABLE 21.—*Consumption of insulating and hard pressed board by end use: 1958–1966**

(In thousands of tons)

SIC	Category	1958	1959	1960	1961	1962	1963	1964	1965	1966
2661110	Insulating board, total†:	1,052	1,172	1,096	1,074	1,078	1,142	1,238	1,258	1,226
2661120	Insulating boards for the retail trade or building construction, total:	963	1,060	1,000	984	974	1,016	1,118	1,127	1,100
2661116	Building board 7/16" or more, natural or primed surface	102	119	128	91	56	51	47	55	56
2661122	Roof insulation board, preformed above deck	192	206	252	255	248	230	238	234	217
2661126	Insulating roof deck slab	30	33	27	32	23	19	18	13	10
2661132	Insulating fiberboard formboard	7	10	9						
	Interior board, factory-finished:									
2661136	Large panels 7/16" or thicker	45	39	33	30	40	51	75	77	79
2661142	Tile, except acoustical	134	130	124	127	120	138	134	135	145
2661146	Acoustical tile	119	134	116	108	105	97	101	93	88
2661152	Plant	13	9	5	4	3	4	4	6	5
2661156	Other (trim, moulding, etc.)									
2661162	Sheathing board	261	319	258	284	334	373	430	424	413
2661166	Shinglebacker	21	31	23	25	24	27	31	29	27
2661172	Wallboard under 7/16", except shinglebacker	25	21	13	15	13	20	36	56	54
2661176	Other insulating board for retail trade or building	14	9	12	13	8	6	4	5	6
2661130	Insulating board for industrial uses, total:	89	114	96	90	104	126	120	131	126
2661182	Insulating siding base	72	70	47	44	38	33	28	23	66
2661186	Back board for siding made of metal	17	23	28	24	31	43	39	40	
2661192	Insulating board for expansion joint strips									
2661196	All other		21	21	22	35	50	53	68	60
2499610	Hard pressed board, total‡:	673	845	774	860	1,002	1,112	1,216	1,300	1,236
2499622	Treated or tempered	311	371	356	358	426	451	474	529	481
2499626	Not treated or tempered	362	474	418	502	576	661	742	771	755

From: U.S. Department of Commerce, Business and Defense Services Administration, "Pulp, Paper, and Board," *Quarterly Industry Report*, 24(1):23–27, Apr. 1968.
U.S. Department of Commerce, Bureau of the Census, "Pulp, Paper, and Board," *Current Industrial Reports*, Series M26A(60–13)—M26A(66–13). Washington, 1961–1967.
Import/export adjustments and forecasts by Midwest Research Institute.
†Density 26 lb/cu ft or less.
‡Density over 26 lb/cu ft.

board.[10] In 1966 the total consumption was almost evenly divided between the two, whereas in 1958 insulating board accounted for 62 percent of the total (Table 20).

Insulating Board

Almost 90 percent of insulating board is used for building construction or the retail trade (which is the do-it-yourself component of building construction and repair). Insulating board is widely used as sheathing board; interior panels; tile, including acoustical tile; and roof insulation board. (See Table 21.) The remaining 10 percent of insulating board is used for such industrial construction materials as insulating siding and backboard for metal siding. Production is somewhat cyclical because of dependence on building construction, but in recent years annual requirements have generally been near or above 1 million tons.

Insulating board can usually be considered a permanent structural component and thus constitutes a minor part of building rubble when the structure of which it is a part is eventually razed, normally several decades after construction.[11] A small portion of insulating board ends up as waste during construction or repair work, but for the most part this portion is minor—in the range of 3 to 10 percent.

Hard Pressed Board

Unlike other woodpulp based construction materials, hard pressed board has shown vigorous growth in recent years.[12] Although its consumption history is variable, total demand increased from 0.67 million tons in 1958 to 1.24 million tons in 1966, a growth rate of nearly 8 percent per year. The primary constituent of hard pressed board is woodpulp, and adhesive binders give it strength and rigidity.

Hard pressed board is used for residential construction and industrial applications; industry estimates indicate about an even split between the two uses. In construction, hard pressed board is used for floor underlayment, prefinished wall paneling, and in conjunction with exterior home siding. It is also used extensively in mobile homes. Industrial applications include automobile panels (e.g., in station wagons), luggage, furniture, fixtures, general millwork, and more recently, preformed or molded shapes. One of the most familiar applications, which has become very popular in recent years, is display or tool-mounting board ("peg board").

Hard pressed board usually becomes a part of a permanent building or is an indistinguishable component of some other product. Therefore the vast bulk disappears in the course of normal consumption and becomes a part of some general (nonpaper) solid waste component such as building rubble. It is estimated that between 1 and 10 percent becomes scrap or waste during conversion processes.

Total consumption of hard pressed board in 1967 (1.12 million tons) was adversely affected by plant shutdowns, and 1968 consumption rose sharply (about 25 percent) as deliveries caught up with order backlogs.

Hard pressed board is one of the few major paper grades for which imports are a significant factor. Imports account for about 13 percent of net U.S. consumption.

Techno-Economic Trends

Consumption of insulating board is dependent on housing construction and repair. In recent years there has been a shift in the types of insulating board that are most popular. For example, the use of natural building board has declined, and the use of factory prefinished panels has increased. Also, exterior sheathing board is gaining more in importance than are the other insulating board applications.

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[10] More recently the density break has been changed to 31 lb/cu ft, but data for years prior to 1967 were taken on the basis of 26 lb/cu ft.

[11] The number of housing demolitions can be derived from U.S. Census of Housing figures on the number of housing units constructed during various periods which are still intact at the time the census is taken. Housing demolitions to 1976 can be estimated on the assumption that future demolition activity will follow past trends. Of the housing constructed prior to 1960, we estimate that there will be a decrease of 5.4 million units in the 1966 to 1976 period—from 55.5 million existing units in 1966 to 50.1 million units in 1976. Housing constructed after 1960 to be demolished in the next decade is estimated at 800,000 units. Therefore, total housing demolitions will amount to 6.2 million units in the 1966 to 1976 period. (Similar information is not available for commercial, industrial, public, and other nonresidential structures. However, housing accounted for about 47.5 percent of the \$51.3 billion spent for residential and nonresidential nonfarm construction in 1966.) By any account, paper and paper products make up only a very minor percentage of building rubble on a tonnage basis.

[12] Hard pressed board is made from wood or other cellulosic fibers that have been refined or partly refined and then felted into a panel under controlled combinations of pressure, heat, and moisture. The board produced has a characteristic natural ligneous bond and a density above 26 lb/cu ft. Thus hard pressed board has essentially the same composition (e.g., wood pulp) as paper and is classified with construction paper and board in U.S. Census reports. (The pulp is usually produced by the defibrated or exploded pulping processes.)

However, insulating board is a generally well-established and widely used construction component. It is unlikely that insulating board will be replaced by other materials within the next 10 years, unless there are radical changes in construction technology.

In the past, hard pressed board was used almost exclusively in applications where flat sheets were required in construction or building repair. However, with recent advances in finishing and shaping techniques, hard pressed board is entering new markets, especially in industrial and consumer products where it serves in general use or specialized applications. Although hard pressed board is expected to remain an important construction material in the next decade, it is likely that competition from various plastic, fiberglass, and prefinished wood products for certain markets will increase.

Forecast

For construction board as a whole, the growth rate is forecast at 4.5 percent per year in the 1966 to 1976 period. This rate will result in consumption of 3.83 million tons in 1976 (Figure 9).

Of the two types of construction board, hard pressed board is expected to have the faster rate of growth.

Hard pressed board is now in a period of strong growth stimulated primarily by relatively new specialized applications for hard pressed board, such as prefinished paneling and the increasing popularity of new molded and shaped products. Per capita consumption, which increased from about 8 lb to 12 lb in the 1960 to 1966 period, will increase to about 20 lb by 1976. This is 2.25 million tons in 1976—a 10-year growth rate of 6.3 percent per year. This forecast is based on a rate of increase of 7.5 percent per year to 1970 and a slower rate of 5.3 percent per year after 1970, which reflects a maturing of the markets as consumption approaches 2 million tons per year.

For insulating board, the forecast was based on historical trends in consumption, with the assumption that housing construction and household repair activity would rise at a rate of about 5 percent per year (in dollars), in the late 1960's and early 1970's. On the basis of a 2.5 percent per year growth rate, the consumption of insulating board would be 1.58 million tons in 1976—an increase of 0.25 million tons over 1966.

NONWOVEN DISPOSABLES

Nonwoven disposables are products that are designed for a short useful life, after which they are meant to be discarded.[13] These products are expected to make a major contribution to the "disposable era" now receiving considerable attention in the paper industry. They will not only compete with and supplement traditional woven fabrics, but also create new markets of their own.

Paper and pulp will play an important role in the technology of nonwoven disposables, and it is important to be aware of the potential use of these clothlike materials, because they will have an increasing impact on solid waste in the next decade. Consumption of nonwoven disposables amounted to about 40,000 tons in 1966. Of this amount, fiber-reinforced paper accounted for more than one-third—15,000 tons.[14]

Nonwovens are made of layers of fibers that have been arranged or oriented to a web structure and joined mechanically or chemically or by fusion. They may be made of one material or a combination of materials. For example, "paper" dresses, which received widespread publicity in 1966, are actually made of nonwoven fabrics or fiber-reinforced paper fabrics containing rayon, nylon, or some other basic fiber in addition to paper. Nonwoven disposables are custom designed to meet specific needs of users; they are neither cloth nor paper and bridge the gap between textiles and paper in cost, speed of production, and performance properties.

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[13] Our terminology here corresponds to that of industry in referring to products or materials that are designed for a short useful life after which they can be discarded. We do not mean to imply that "disposables" are necessarily of minor concern as viewed from a solid waste standpoint.

[14] Actually, about 110,000 tons of nonwovens were produced in 1966, but this was for all end uses and materials, while the emphasis in this discussion is on the disposable markets for which paper will compete. Some of the nonwoven products excluded here are blankets, carpet face and backing, wall coverings, drapes, and coated fabrics and laminated plastics.

Techno-Economic Trends

The paper industry has looked to nonwoven disposables as a promising area in which to develop new markets. Some major paper companies—including those who now produce tissue—are entering directly into the manufacture and marketing of nonwovens. However, even the most optimistic estimates of new tonnage consumption place it at under 1 percent of total paper requirements in 1976, although by that time, sales of all nonwoven products will amount to $1 billion. Four major industries—paper, textiles, chemicals, and plastics—are now in competition for the emerging markets for nonwovens. Materials such as cellulose wadding, rayon, nylon, polyester, polyethylene, and the like are the materials that in various combinations and forms make up the nonwoven material spectrum.

Nonwoven disposables are attractive for many potential uses because their performance characteristics—strength, tear resistance, flexibility, absorbency, drape, durability, permeability, wet strength, and so forth—can be closely engineered to meet the requirements of various applications. This adaptability should give added impetus to the growth of many markets.

At present, most of the potential for nonwoven disposables is in institutional products, with hospitals a prime target, followed by various consumer and industrial applications.

In the medical field (essentially hospitals), manufacturers are developing nonwoven disposables for use in medical, surgical, and sanitary supplies; bed linen; surgical linen; protective clothing (caps, gowns, masks, aprons); diapers; stretch sheets; and other items. The potential of the hospital market is enormous. For example, if only one percent of the daily bed sheet changes in hospitals were made with disposables, this would require 32.5 million sheets—about 200 million square yards of nonwoven material per year.

Additional important factors that contribute to the potential use of nonwovens in the medical field are general sanitation and elimination of cross infection and staining. Because of rising labor costs and scarce labor supply, elimination of laundering may justify the cost of disposables for at least part of an institution's requirements. Use of disposables might also reduce pilferage, which costs hospitals an estimated 500,000 cloth sheets per year.

In industrial and consumer applications, such factors as low cost, time savings, and convenience of use will strongly encourage the use of nonwoven disposables. The products most likely to develop rapidly are industrial wipers and toweling; some types of clothing, including uniforms and dresses; baby diapers; and treated cloths for dusting, shining, mopping, and cleaning.[15]

Several basic production processes are available, each of which is useful for certain materials:

(1) dry processes, which require the use of conventional textile machinery and fibers 1½ in. long or longer.

(2) wet processes, which are based on papermaking technology and machinery utilizing short pulp fibers as well as man-made fibers in combination with the pulp.

(3) spun bonding, a relatively new technology that combines randomly arranged continuous filament fibers with spinning, web formation, and bonding in a highly integrated process.

(4) Kröyer, a paper-making process by which air- and static-charged plates are used to orient short fibers and form a web that has a three dimensional appearance.

(5) formation of fiber reinforced paper fabrics by placing reinforcing yarn or mesh (scrim) between layers of paper or cellulose wadding.

Both the Kröyer process (Danish) and the Feldmuhle process (German), a wet process, have been licensed in this country. The fiber-reinforced paper process is based on U.S. patents and is also licensed to manufacturers of nonwoven disposables. Several paper companies, as well as chemical, textile, and plastic companies, have made substantial commitments to develop nonwoven disposables into a significant business.

At this point it is difficult to determine which processes and which material or material combinations will dominate in the future. For example, the pulp content of nonwovens utilizing wood pulp varies between 93 percent and under 25 percent;

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[15] This list does not include items such as wall coverings, blankets, curtains, carpet backing, and a host of other products which do not fit into our definition of nonwoven disposables.

some nonwovens have no pulp content whatsoever. However, it seems certain that nonwovens will be primarily based on natural or man-made fibers now available and will come into widespread use in a variety of applications as disposables.

Forecast

MRI estimates that in the 10-year period between 1966 and 1976 the consumption of nonwoven disposables will quadruple in fiber tonnages from 40,000 tons in 1966 to 200,000 tons in 1976 (of all materials: paper, rayon, nylon, etc.). The forecast is based in particular on the growth potential in hospital and medical applications, which will account for about 60 percent of consumption. Industrial applications (wipers, etc.) and consumer applications (clothing, diapers, cloths, towels, etc.) will account for the balance. This increase is an average growth rate of 17.5 percent per year. Thus nonwoven disposables will become as important in tonnage as are many paper grades in use today.

PART III

THE IMPACT OF NONPACKAGING PAPER ON SOLID WASTE

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The basic objective of this study was to establish the proportions of nonpackaging-paper tonnage that entered the solid waste stream in 1966 and that would do so in 1976. The general approach used in determining these proportions and the findings of these efforts are presented in this section.

In 1966, 27.3 million tons of nonpackaging paper were consumed. In the same year, 19.7 million tons were disposed of by various means; this figure represents 72 percent of the total consumed in 1966. However, not all of the tonnage disposed of in 1966 was paper consumed in that year. According to our estimates, 16.9 million tons came from 1966 consumption, 2.0 million tons from the 1961 to 1965 period, and 0.8 million tons from the 1956 to 1960 period. In addition, not all of the paper that is discarded in 1 year enters the waste stream directly. In 1966, about 27 percent of the discarded paper, 5.4 million tons, was recycled. Other paper was used in products which are identified with another waste component (e.g., automobiles, buildings) and some was retained permanently by the users.

In arriving at these figures we met many problems. The most basic problem is the almost complete lack of data on disposal practices for specific grades of papers that are retained more than 1 year. For some types of paper, such as business papers and forms, it was possible to establish broad guidelines by spot checking different types of businesses to determine their disposal or retention policies. For the most part, however, it was necessary to make judgments on disposal and retention characteristics based on our everyday experience and common knowledge.

Our efforts to locate data also included numerous attempts to uncover unpublished data on paper product retention and disposal practices of businesses, industry, and institutions and consumers. Most of these attempts met with only limited success. We were able to establish some guidelines for conversion waste percentages and generalized data on office paper retention cycles. It would have been helpful to make a detailed, broadly based survey, but the results probably would not have justified the costs, given the overall objectives of this analysis.

GENERAL APPROACH

The basic method used to determine the impact of nonpackaging paper on solid waste consisted of three steps: (1) grouping of the seven-digit grades of nonpackaging paper and paperboard into seven general end-use categories; (2) development of an estimated life-cycle profile for each type of paper and paperboard; (3) calculation of the quantities of each grade that did enter the waste stream in 1966 and that would enter it in 1976.

Classification Into Seven End-Use Categories

As a group, the nonpackaging papers do not have a typical life cycle that permits an overall estimate of the solid waste generated by such materials. For example, some paper products are used and then disposed of almost immediately. Paper napkins, paper towels, and facial tissues have a very short life and are designed to be used only once and then discarded. Other paper products have a significantly longer life expectancy and do not enter the solid waste stream until years after they are produced. Hard-cover books are a good example of a product with a relatively long life—measured in years rather than in days or months. Other paper grades become integral parts of a product and cannot be recognized as paper. Shoes, electrical cable, and automobiles are examples of products that have paper components. Some papers are recognizable as such but are combined with other materials in such a way that they should no longer be considered paper products. An example is construction board in buildings; it has a useful life measured in decades and enters solid waste as a part of building rubble many years after its manufacture.

To overcome the problems of analyzing these greatly varying life cycles of all the grades of paper and paperboard, seven end-use classifications were established[16]:

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[16] Nonwoven disposables will be found distributed among three of these classifications. For example, nonwoven medical products are in (4), diapers and apparel in (5), and wiping cloths, uniforms, and others are in (6).

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(1) *Newspapers.* All daily, weekly, local, and national newspaper and Sunday supplements that normally use newsprint.

(2) *Publishing.* Printed periodicals, directories, catalogs, and books that are made from coated or uncoated printing papers. Paperboards that go into book bindings are also included.

(3) *Commercial printing.* Commercial printing done on coated or uncoated printing paper. It includes direct mail advertising, promotional material, brochures, booklets, and other items normally produced by commercial printers. However, this definition is not meant to encompass all of the paper grades which commercial printers may handle.

(4) *Business, institutional, and government uses.* Fine paper, printing paper, special industrial paper, and special paperboard that are used in office operations of business, industry, and government. Included are stationery, office printing papers, office machine papers, file cards, file materials, tablets, adding-machine tapes, etc. In addition, a small number of institutional and consumer products, such as school supplies, personal stationery, and specialty printing items, is included.

(5) *Consumer and personal products.* Personal products including sanitary tissue papers, such as toweling, napkins, toilet tissue, and other products consumed primarily by individuals for personal care or individual uses. No attempt is made to specify whether the products are used at home, public, industrial, or office locations.

(6) *Industrial.* This end use includes two types of paper and paperboard products: products that can be identified primarily as paper but that find prominent application in industrial locations; examples are abrasive papers and filter papers; and industrial papers and paperboards that become a part of finished products and are not identifiable as a paper or paperboard product. Examples are shoes, automobiles, luggage, toys, furniture, etc.

(7) *Construction.* All paper and paperboard products that are manufactured to go into some type of construction—industrial or private. These products may or may not be identifiable in their original form and normally become a part of a finished structure. Examples are gypsum board liner, roofing felts, insulating board, and wall panels. This category is distinct from industrial categories and includes only paper and board manufactured for some type of building construction.

The products within each end-use category generally have a characteristic life expectancy of about the same length. For example, papers and paperboards used in newspapers, commercial printing, converting, and consumer and personal products all have a relatively short life and are disposed of rapidly. The business, government, institutional, publishing, and industrial categories encompass products with an intermediate life that varies from immediate disposal to 10 years or more. Products in the construction category have life expectancies exceeding 10 years. As may be observed from Table 22, 85 percent of total consumption goes into products with a short or intermediate life cycle, with two-thirds of the total in end products having very short life cycles.

In general, each major paper grade fell predominantly into one of the seven end-use categories. For example, newsprint is used primarily in publishing, only a small amount being used in other types of printing. The paper grades constitute 78 percent of total consumption of nonpackaging paper and board and have short or intermediate life spans. The nonpackaging paperboard grades, accounting for 22 percent, tended to fall into end uses which have a relatively long life, or were components of other products not identifiable as paper, or made contributions to other components of solid waste (e.g., building rubble) which were not a part of this analysis.

In general, the tonnages in the seven end-use classifications were fairly evenly distributed, although newspapers made up 31 percent of the total. Commercial printing accounted for 7.3 percent, and

TABLE 22.—*Consumption of nonpackaging paper and paperboard by end use: 1966**

(In thousands of tons)

Category	Total consumption	Percent of total
Newspapers	8,456	30.9
Publishing	4,197	15.4
Commercial printing	2,000	7.3
Business, government, institutional	3,858	14.1
Consumer, personal	3,055	11.2
Industrial	1,633	6.0
Construction	4,122	15.1
Total	27,321	100.0

*Source: Midwest Research Institute.

industrial, 6 percent; the other four categories range between 11 and 15 percent of the total consumption. A summary of the consumption of paper by grade and end-use classification is given in Table 23 for 1966 and Table 24 for 1976. These data show the relative importance of the various major grades in each end-use category.

Development of a Life-Cycle Profile

Once the various paper grades had been assigned to end-use categories, it was possible to develop a life cycle or solid waste profile of the rate at which each grade would enter the solid waste stream. The waste profile describes a particular paper grade's

TABLE 23.—*Consumption of nonpackaging paper and paperboard by grade and end use: 1966**
(In thousands of tons)

Paper grade	News-papers	Publishing (magazines books, etc.)	Com-mercial printing	Business, institu-tional	Consumer products	Industrial	Construc-tion	Total all categories
Newsprint	8,456	637	—	—	—	—	—	9,093
Printing papers	—	3,342	2,000	422	—	—	—	5,764
Fine papers	—	—	—	2,602	—	95	—	2,697
Special industrial papers	—	—	—	583	—	333	—	916
Sanitary tissue	—	—	—	—	2,825	—	—	2,825
Paper, total	8,456	3,979	2,000	3,607	2,825	428	—	21,295
Special paperboard	—	153	—	251	230	504	765	1,903
Wet machine board	—	65	—	—	—	91	—	156
Construction paper	—	—	—	—	—	—	1,505	1,505
Construction board	—	—	—	—	—	610	1,852	2,462
Paperboard, total	—	218	—	251	230	1,205	4,122	6,026
Paper and paperboard, total	8,456	4,197	2,000	3,858	3,055	1,633	4,122	27,321
Percent of total	31.0	15.3	7.3	14.1	11.2	6.0	15.1	100.0
Nonwoven disposables	—	—	—	18	15	5	—	41

*Source: Midwest Research Institute.

TABLE 24.—*Consumption of nonpackaging paper and paperboard by grade and end use: 1976**
(In thousands of tons)

Paper grade	News-papers	Publishing (magazines books, etc.)	Com-mercial printing	Business, institu-tional	Consumer products	Industrial	Construc-tion	Total all categories
Newsprint	10,600	800	—	—	—	—	—	11,400
Printing papers	—	4,300	3,315	595	—	—	—	8,210
Fine papers	—	—	—	3,680	—	120	—	3,800
Special industrial papers	—	—	—	685	—	400	—	1,085
Sanitary tissue	—	—	—	—	4,670	—	—	4,670
Paper, total	10,600	5,100	3,315	4,960	4,670	520	—	29,165
Special paperboard	—	210	—	355	325	710	950	2,550
Wet machine board	—	80	—	—	—	100	—	180
Construction paper	—	—	—	—	—	—	1,820	1,820
Construction board	—	—	—	—	—	1,130	2,700	3,830
Paperboard, total	—	290	—	355	325	1,940	5,470	8,380
Paper and paperboard, total	10,600	5,390	3,315	5,315	4,995	2,460	5,470	37,545
Percent of total	28.2	14.3	8.8	14.2	13.3	6.6	14.6	100.0
Nonwoven disposables	—	—	—	120	50	30	—	200

*Source: Midwest Research Institute.

life cycle in terms of the percentage of a year's total consumption entering the waste stream. For each grade we selected four stages for the life cycle at which the product may enter the waste stream as paper. In general, paper products would become solid waste: (1) in the year of production; (2) 1 to 5 years after production; (3) 5 to 10 years after production; or it is (4) diverted, which means either that the product is permanently retained, and thus is not a solid waste component, or that it may become part of a product such as automobiles or buildings which is encompassed by some other solid waste classification.

An example will illustrate how the solid waste profile works. For newsprint going into newspapers the waste profile is expressed as: 95/4/0.5/0.5. This means that 95 percent of the tonnage consumed in any one year would end up as solid waste in that year; that 4 percent would end up being disposed of from 1 to 5 years after the year it was produced; that one-half percent would end up being disposed of in 5 to 10 years after it was produced, and that the remaining one-half percent would be permanently retained and not enter the solid waste stream.

A waste profile was developed for each of the seven major paper grades for each end use to which it was assigned. In all, 45 separate waste profiles were developed for the various paper grades, some of which were made up of subprofiles of two or more separate estimates.

Calculation of Quantities Entering Waste Stream

The third step in the development was to make the actual calculation of the quantity of paper which was disposed of in 1966 and that which would be disposed of in 1976. To do so, it was only necessary to apply the waste profile percentages in reverse. A few simplifying assumptions were made to facilitate the calculations. For example, one of the assumptions was that the waste percentage, as applied to the consumption of the midpoint year, would yield the same results as if a separate calculation were made for each of the separate years in each category of the waste profile. To establish the quantity of paper entering as solid waste in 1966, the "same year" waste percentage was applied to the consumption for 1966; the "1- to 5-year" waste percentage was applied to the consumption for 1963; and the "5- to 10-year" waste percentage was applied to the consumption for 1958. (It was, of course, not necessary to make a calculation for the portion that the profile established would not enter as a solid waste, i.e., diverted, for one reason or another.)

Again turning to our example of the newsprint consumed in newspapers, the calculation of the tonnage entering as solid waste in 1966 was made as in Table 25. Thus, of the 8,345,000 tons of newsprint for newspapers entering as solid waste in 1966, 8,032,000 tons are from newsprint produced in 1966; 282,000 tons are from newsprint produced between 1961 and 1965, of which the midpoint year is 1963; and 30,000 tons are from the 1956 to 1960 period, of which the midpoint year is 1958.

TABLE 25.—*Calculation of newsprint entering as solid waste in 1966**

Year	Total consumption (1,000 tons)	Percent entering as waste in 1966	Waste quantity in 1966 (in 1,000 tons)
1966.....	8,456	95.0	8,033
1963.....	7,047	4.0	282
1958.....	6,059	0.5	30
Total......................................			8,345

*Source: Midwest Research Institute.

The calculations for the solid waste tonnage estimated in 1976 were made using the base years 1976, 1973, and 1967 (the last year for which actual consumption figures are available).

DISPOSAL PROFILES

The result of the analysis of end-use classifications and product life profiles was the calculation of the amounts of nonpackaging paper that entered the solid waste stream in 1966 and that would do so in 1976. The widely different end uses for some of the major grades result in a wide variation in the percentage of a particular grade that will end up as solid waste in a given year. In 1966, for example, the total newsprint discarded was equivalent to 98.5 percent of that year's consumption.[17] In the case of construction board the amount discarded was equivalent to only 7.7 percent of 1966 consumption.

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[17] This ratio is given for comparative purposes. It should be noted that the 98.5 percent applies to the quantity entering as solid waste compared with the quantity consumed that year. It does not mean that 98.5 percent of the actual 1966 consumption became solid waste that year; this figure must be obtained from the "waste profile."

A series of seven tables (26 to 32) present the results of detailed analysis of the consumption of nonpackaging paper in 1966 and in 1976, the waste profile assigned to each end-use classification for each grade, and the quantity from each end use entering the solid waste stream in 1966 and in 1976. These data served as the basis for making the calculations of solid waste for two base years. However, the actual calculations cannot be made from the data in these tables, because consumption figures which apply to the second and third steps in each solid-waste profile are not included in the tables. The

TABLE 26.—*End use and solid waste profiles for newsprint: 1966 and 1976**

End use	Consumption (thousand tons) 1966	Solid waste profile; percent entering in:			Percent diverted	Thousands of tons:		
		Same year	1 to 5 yr.	5 to 10 yr.		Entering solid waste 1966	Consumption 1976	Entering solid waste 1976
Newspapers	8,456	95.0	4.0	0.5	0.5	8,345	10,600	10,500
Publishing	637	80.0	18.0	1.5	0.5	612	800	781
Total	9,093					8,957	11,400	11,281

*Source: Midwest Research Institute.

TABLE 27.—*End use and solid waste profiles for printing paper: 1966 and 1976**

End use	Consumption (thousand tons) 1966	Solid waste profile; percent entering in:			Percent diverted	Thousands of tons:		
		Same year	1 to 5 yr.	5 to 10 yr.		Entering solid waste 1966	Consumption 1976	Entering solid waste 1976
Catalogs, directories	694	90.0	8.0	1.5	0.5	670	1,000	986
Magazine publishing	1,938	65.0	25.0	5.0	5.0	1,779	2,200	2,040
Book publishing	710	20.0	33.0	17.0	30.0	350	1,100	636
Commercial printing	2,000	85.0	8.0	4.0	3.0	1,853	3,330	3,141
Business-converting	422	80.0	10.0	5.0	5.0	390	580	537
Total	5,764					5,042	8,210	7,340

*Source: Midwest Research Institute.

TABLE 28.—*End use and solid waste profiles for fine paper: 1966 and 1976**

End use	Consumption (thousand tons) 1966	Solid waste profile; percent entering in:			Percent diverted	Thousands of tons:		
		Same year	1 to 5 yr.	5 to 10 yr.		Entering solid waste 1966	Consumption 1976	Entering solid waste 1976
Business, government, institutional:								
Writing, rag	133	35	20	33	12	108	150	126
Writing, chemical†	1,948	45	20	30	5	1,490	2,835	2,474
Bristols	167	50	20	10	20	127	250	185
Cover paper	56	50	30	10	10	47	60	53
Text paper	130	20	60	10	10	94	180	148
School paper	24	85	5	5	5	21	30	28
Thin paper	144	100	0	0	0	144	175	175
Subtotal	2,602					—	3,680	—
Industrial (thin)	95	85	5	0	10	84	120	107
Total	2,697					2,115	3,800	3,296

*Source: Midwest Research Institute.
†1976 profile—same year: 50 percent; 1 to 5 years: 30 percent; 5 to 10 years: 15 percent; diverted: 5 percent.

TABLE 29.—*End use and solid waste profiles for special industrial paper: 1966 and 1976**

End use	Consumption (thousand tons) 1966	Solid waste profile; percent entering in: Same year	1 to 5 yr.	5 to 10 yr.	Percent diverted	Thousands of tons: Entering solid waste 1966	Consumption 1976	Entering solid waste 1976
Industrial	333	40	7	8	45	174	400	211
Business, government, institutional:								
Tab cards	514	50	40	5	5	426	600	565
File folder	69	15	20	40	25	37	85	53
Total	916					637	1,085	829

*Source: Midwest Research Institute.

TABLE 30.—*End use and solid waste profiles for sanitary tissue: 1966 and 1976**

End use	Consumption (thousand tons) 1966	Solid waste profile; percent entering in: Same year	1 to 5 yr.	5 to 10 yr.	Percent diverted	Thousands of tons: Entering solid waste 1966	Consumption 1976	Entering solid waste 1976
Consumer products:								
Sanitary napkins	34	100	0	0	0	34	40	40
Toweling	896	100	0	0	0	896	1,720	1,720
Toilet tissue†	1,184	25	0	0	75	296	1,700	425
Napkins	312	100	0	0	0	312	465	465
Facial tissue	332	100	0	0	0	332	480	480
Wiper stock	45	100	0	0	0	45	65	65
Other tissue	22	100	0	0	0	22	200	200
Total	2,825					1,937	4,670	3,395

*Source: Midwest Research Institute.
†All enters in first year but most is digested during sewage treatment.

interested reader can, with due care, derive these figures from other tables in this report.

The general basis for the calculations for each major paper grade are summarized below. As noted previously, the profiles are based on limited data that were developed indirectly from the nature of the end uses. Even though these calculations rely on "best judgments," they provide a useful approach in determining the impact of paper on solid waste.

The evaluation requiring the most critical judgment was that for the "diverted" class, because that represented amount permanently retained or disappearing into another product not identifiable as paper. Thus the diverted portion does not appear as paper solid waste, and any error in accounting for it would alter the quantities estimated to be a portion of solid waste. By contrast, a waste profile that is too rapid or too slow does not change the total amount of solid waste but simply distributes its entry differently over time.

Basis for Profiles

Newsprint (*Table 26*). Newsprint products are, by design, of limited value over time and are not saved permanently except in isolated instances. Consumers usually discard newspapers within hours or days after reading them. (Also, about 2.5 percent is production waste.) Newsprint deteriorates with time or repeated use. Therefore the profile was based on a very high discard rate in the same year of consumption with only a token amount of 0.5 percent retained permanently.

Printing paper (*Table 27*). With the exception of books, most printed products on printing paper grades have a relatively short life span, and permanent retention is of minor importance. The five profiles under this grouping were developed on this basis. In addition, as noted previously, conversion waste accounts for 15 to 18 percent of total consumption for magazines, periodicals, catalogs, and similar products.

TABLE 31.—*End use and solid waste profiles for special paperboard: 1966 and 1976**

End use	Consumption (thousand tons) 1966	Solid waste profile; percent entering in:			Percent diverted	Thousands of tons:		
		Same year	1 to 5 yr.	5 to 10 yr.		Entering solid waste 1966	Consumption 1976	Entering solid waste 1976
Publishing:								
Bending board	53	15	25	15	45	25	60	33
Nonbending board	100	15	25	15	45	40	150	69
Subtotal	153					65	210	102
Business, govt., institutional:								
Cardboard	84	40	20	30	10	75	95	75
Other special paperboard	167	15	20	40	25	60	260	157
Subtotal	251					135	355	232
Consumer products:								
Solid groundwood	38	100	0	0	0	38	40	40
Nonbending board	173	15	20	50	15	108	260	185
Cardboard	19	40	20	30	10	17	25	16
Subtotal	230					163	325	241
Industrial:								
Panel board	44	10	0	0	90	4	50	5
Bending board	150	15	20	30	35	82	190	110
Nonbending board	160	10	30	30	30	82	230	141
Other special paperboard	150	15	0	0	85	22	240	28
Subtotal	504					190	710	284
Construction:								
Building board	765	10	0	0	90	77	950	95
Total	1,903					630	2,550	954

*Source: Midwest Research Institute.

TABLE 32.—*End use and solid waste profiles for wet machine board and construction paper and board: 1966 and 1976**

End use	Consumption (thousand tons) 1966	Solid waste profile; percent entering in:			Percent diverted	Thousands of tons:		
		Same year	1 to 5 yr.	5 to 10 yr.		Entering solid waste 1966	Consumption 1976	Entering solid waste 1976
Publishing:								
Binders board	65	15	25	15	45	31	80	40
Industrial:								
Shoe board	59	15	0	0	85	9	65	10
Other wet machine	32	15	0	0	85	5	35	5
Hard pressed board	610	10	0	0	90	61	1,130	113
Subtotal	701					75	1,230	128
Construction:								
Construction paper	1,505	8	0	0	92	120	1,820	146
Insulating board	1,226	8	0	0	92	98	1,580	126
Hard pressed board	626	5	0	0	95	32	1,120	56
Subtotal	3,357					250	4,520	328
Total	4,123					356	5,830	496

*Source: Midwest Research Institute.

Most catalogs and directories are of transitory value (the best examples are telephone books and mail-order catalogs) and are replaced periodically; thus we estimate 90 percent discard in the same year of consumption. Magazines have a certain permanency or value to many people, but ordinarily they are discarded. Only certain ones (such as the National Geographic and special commemorative or memorial issues) are retained permanently by some consumers. Thus, although our profile recognizes a retention value above that for catalogs, it assumes most magazines are discarded within 5 years.

Books have intrinsic value to many individuals, and a large proportion become permanent possessions. The book profile was developed from reports of the number of books produced by binding method (hard-cover and soft-cover) and by general subject—school textbooks, technical, religious, general, and so forth. Again, retention data are not available, but the profile was based on a life cycle for each of seven types of general subject matter and type of binding—hardbound or softbound. Thus there were 14 separate subprofiles. High school and grammar school textbooks were estimated to be discarded mainly in the 1- to 5-year time span. For other books the proportion being discarded was more evenly divided among the time spans. Softbound books are generally of lower value and less durable and were assigned to faster disposal cycles than were hardbound books. Our estimates of permanent retention varied from 10 percent for some softbound books to 70 percent for basic reference books. The profile in Table 27 is the composite of the 14 subcategories on the basis of number of books sold in 1966.

Commercial printing is heavily influenced by direct mail advertising, promotional materials, and brochures and booklets. These materials are mainly of limited value over time. Only a few special booklets may have permanent value. Thus the vast majority are discarded before a decade has passed. On this basis we estimate that only 3 percent of such material is of permanent value; 85 percent (including conversion waste is discarded within the first year.

Most converted products are used in office, government, and institutional applications and consist mainly of working paper, tapes, and the like. For this reason converted products have a low retention value, and permanent retention has been estimated at 5 percent.

Fine paper (*Table 28*). By far the greatest use of fine paper is in business and government for office papers of various types, such as stationery, forms, copy paper, and reproduction. We were able to obtain limited documentation of retention cycles, but actual practices are not known. For example, the record retention policy of a particular organization can be very explicit but may not be followed in practice. A significant waste input is derived from conversion of fine papers. The waste in producing business forms is 10 to 12 percent, while in-house reproduction departments may discard 5 to 35 percent of a run, depending on its length and finish requirements. About 5 percent of stationery and similar products never reach a finished form. Overall estimates of retention vary. Discard cycles for all office papers of 25/45/20/10 and 40/20/35/2 are two of those derived from our inquiries to businesses. Making allowances for conversion waste, the profile for writing papers was finally established as shown in Table 27, rag content paper having a slightly longer retention than that of other writing papers.

Bristols were assigned a relatively high retention value of 35 percent because of the relatively high proportion that go into library file cards and other permanent records. Cover and text papers are used for high quality publications, such as annual reports, of intermediate value to users. Because cover stock is also used for restaurant menus, it was given a relatively faster discard profile than text paper.

School paper is consumed mostly as scratch paper and in artwork. It was assumed that a small portion (5 percent) had sentimental retention value, but that most would be discarded in the first year.

Because thin paper is used primarily for carbon paper and has no retention value, it is discarded in the same year of consumption. The industrial uses of thin paper are primarily for cigarette making, interleaving of condenser plates, and the like. Cigarette paper is eventually partly destroyed in use, of course, but an estimated 10 percent of thin paper in industrial uses goes into other products and is thus diverted in use.

Special industrial paper (*Table 29*). It was determined that about half of the industrial uses for special industrial paper is for products such as cable, electrical insulation, gaskets, vulcanizing stock, and so forth, and thus is diverted in use to other solid waste categories. The other half is consumed in expendable products such as abrasive paper, filter paper, and absorbent paper. Therefore most, but not all, special industrial paper is discarded the same year it is produced. The combination of two different use profiles gave a composite profile that was weighted heavily at the extremes—immediate discard and diversion to other applications.

Tab cards usually serve as input for computer systems or other automated data-handling systems. Once the function of the data entry or recording is completed, the cards may be retained for a short time but usually have very limited value for re-use. They are discarded rapidly by most users. We estimate that 90 percent are disposed of well before 5 years, and that 5 percent or less are of permanent value.

In contrast, file folders may survive several record purging steps and have a longer life than the records that they organize. For this reason, we estimated one-fourth of the file folder tonnage is of permanent value, and the remainder is discarded relatively slowly over time.

Sanitary tissue (*Table 30*). Tissue has one of the most clear cut use profiles of all paper grades. Products of tissue are nearly all designed to be used once and then discarded by the user. Therefore, all of the categories were classed as 100 percent discard in the year of consumption. However, because toilet tissue follows a totally different disposal mode from other paper products, a substantially different profile was used. Although it is definitely meant to be discarded, it enters the sewage system and reaches sewage treatment facilities as an insoluble component of sewage. In the treatment process the cellulose content is generally reduced by anaerobic digestion. In an optimized system about 95 percent digestion occurs. However, few treatment plants now in use achieve this efficiency of reduction. We have estimated that 25 percent of toilet paper carries over into sewage plant sludge after all treatment stages, including onsite incineration. This residue is part of the treatment sludge considered solid waste.

Special paperboard (*Table 31*). There are a number of end uses for special paperboard; it is the most diverse category within nonpackaging paper and falls into five of the seven end-use classifications. The paperboards (bending and nonbending) that are used in publishing go into bindings for hardcover books, ledgers, and the like. Because hardbound books are used for many years and may be permanently retained, the profile was weighted to a long term cycle. The profile chosen is consistent with that used for hardbound books in the printing paper category, nearly one-half being permanently retained.

Cardboard and other special paperboard used in business and government are typically used for such items as writing tabletbacks, display posters, post cards, and file folders. Very few specific data were available for this category, however. The profile for cardboard was judged to be similar to that for writing (fine) paper; for the "other" category, a large portion is expanding (e.g., "red wallet") file folders, so the same profile was used as for file folders under the special industrial paper category.

Consumer products are another end use that employs a significant quantity of special paperboard. Solid groundwood is used for book matches; their life cycle is very short, so all of it has been included as first-year discard. On the other hand, cardboard and nonbending board are used for games, toys, puzzles, photomount, playing cards, and other products that are semi-permanent and have relatively long life cycles. Although we judged that 10 to 15 percent might be permanently retained, most of these products would be discarded within 10 years. Products in the cardboard category would typically have a shorter life span than would nonbending board products. Therefore a distinction was made between the rates at which they would become waste.

Industrial uses of special paperboard also vary widely. For applications in which paper is of secondary importance, a conversion waste factor was estimated and the balance was considered "diverted." Thus, panel board which goes into automobiles is diverted outside the paper classification. Other products in the industrial category include board used in luggage, platforms, gaskets, appliances, furniture, and sign boards. Most of the end uses are of relatively long life but are not necessarily permanently retained or diverted into other uses. The profiles used are estimates which are thought to be typical but the almost total lack of data precluded development of profiles as useful as most of the others made in the course of evaluation.

The construction end use of paperboard includes primarily liner for gypsum board but also laminated wall board and other building board. Because it is used almost exclusively in permanent structures such as homes, the profile is based simply on 10-percent conversion or scrap loss and 90-percent diversion.

Wet machine board (*Table 32*). The binders board category of wet machine board is used for book bindings, and the profile developed is the same as that for typical hardbound books under the printing paper category for books.

Shoe board is a diverted use; only scrap or conversion waste, amounting to 15 percent, is considered to be a factor in paper waste. The same approach was used to determine the waste profile for other uses of wet machine board.

Construction paper (Table 32). Construction paper is used for building structures, mostly roofing felts. It therefore falls in the diverted category, with an estimated 8-percent scrap in the year of consumption.

Construction board (Table 32). Insulating board is also used in building construction and therefore falls in the diverted category, with an estimated 8-percent scrap in the year of consumption. About half of hard pressed board is used in building construction and falls in the diverted category, with an estimated 5-percent waste in the year of consumption. The other half of hard pressed board is used in other applications such as furniture, appliances, automobiles, and display panels. However, it too is diverted, and except for an estimated 10-percent waste in the year of consumption, it is not a factor in the paper portion of solid waste.

Nonwoven disposables. By definition, only those nonwovens with a very short life span were included in this analysis. Therefore they are treated in the same way as tissue for the waste profile—100 percent are discarded in the year of consumption. Because the category includes materials other than paper, such as plastics and textiles, it is shown separately in the summary data (Table 34).

CONCLUSIONS

The process by which we arrived at our conclusions about the current trends in nonpackaging paper consumption and our forecasts for 1976 consumption was based on a number of elements. The general approach in this analysis is described in the section on methodology and in the detailed observations that have been developed throughout Parts II and III.

The 1976 forecasts are based on historical trends and growth rates and on forecasts published by the American Paper Institute and the U.S. Forest Service. In addition, the consumption trend for each seven-digit grade was analyzed with respect to historical growth patterns and their relationship to gross national product and disposable personal income. Each analysis of paper consumption was further extended by a review of current literature to identify trends in the paper-using sectors (the "demand determinants") of the economy—printing and publishing, office operations, data processing, consumer products, and so forth. In analyzing each of the demand determinants, we identified a number of significant factors. These factors include the use of specialized laminations, coatings, inks, and other treatments that make paper products more complex and heterogeneous; the advent and acceptance of direct data input for data processing, reducing the need for tab cards; and the indirect impact of data storage on paper consumption (the number of original paper documents is not reduced, but they may be stored in nonpaper form).

Our analysis was supplemented by personal interviews with industry experts in the major industry associations, with major paper manufacturers, and with companies that influence the consumption of paper and paper products.

All of these elements were combined to produce observations and conclusions that are presented throughout this report. The 1976 forecasts are based on information derived from both the producing and the consuming elements of industry that determine the future demand for paper products. As a final test of the analysis, industry experts were asked to review and comment on our findings; these comments were also taken into account. (Of course, MRI is responsible for all statements in this report.)

As was mentioned early in Part III, no published references were available on which to base the concept of disposal profiles. The profiles are original work, developed to alert the reader to the way in which the consumption of paper and paper products relates to the Nation's solid waste problem. To the extent possible, the profiles were based on actual practices, although this part of the analysis remains an educated guess subject to revision if actual data become available. However, it is likely that the approach would remain the same.

The following statements are MRI's general conclusions on the impact of these disposal factors on solid waste, especially on what may be expected in 1976 as compared with 1966. These statements are addressed to the objective stated in the Introduction to this report: to determine the paper and paperboard tonnage that will reach disposal facilities in 1976.

The result of the various steps described here was a summary by grade of the total paper and paperboard discarded in the two base years 1966 and 1976. In addition, the effect of recycled paper was taken into account. Our calculations indicate that 19.7 million tons of nonpackaging paper were disposed of in 1966; of this amount, 5.4 million tons were recycled. Thus, 14.3 million tons became a part of the Nation's solid waste stream in that year. By 1976 this amount is expected to increase by 6.3 million tons (44 percent) to 20.6 million tons (Table 33).

Table 33.—*Summary of nonpackaging paper consumption, solid waste and recycling: 1966 and 1976**

(In millions of tons)

Year	Total consumption†	Total to be disposed of‡	Total recycled	Total to solid waste§
1966.......	27.3	19.7	5.4	14.3
1976.......	37.7	27.8	7.2	20.6

*Source: Midwest Research Institute.
†Includes nonwoven disposables.
‡From current year or previous years' consumption.
§Total to be disposed of less that recycled.

In total, 18.7 million tons of paper and paper products were disposed of in 1966; this is equal to 87.8 percent of total consumption for that year. On the other hand, only 0.99 million tons of paperboard were disposed of, representing only 16.3 percent of consumption for that year. A detailed summary of paper and paperboard grades entering the solid waste stream in 1966 and 1976 is found in Table 34. The quantities entering as solid waste in any year are made up of a portion of that year's consumption plus portions of previous years' consumption based on the waste profile. Thus the column for percentage of 1966 or 1976 consumption is useful only for comparative purposes in judging in what proportion and how rapidly a particular grade becomes a factor in solid waste. Also included in this table are the nonwoven disposables discussed in Part II of this report. Nonpackaging paper and paperboard recycled for use as raw materials in paper manufacture are also shown in this table as a net deduction from the solid waste stream.

To take into account the impact of all recycled paper and paperboard, a summary for the whole paper industry (packaging and nonpackaging) is given in Table 35. These summary data show the contribution of paper industry products to solid waste in the base years. Paper industry products accounted for 352 lb per capita of solid waste in 1966 and are expected to account for 458 lb per capita in 1976. These figures illustrate that paper industry products are a highly significant factor in solid waste generated in the United States. The volume of paper and paperboard that becomes a part of our Nation's waste, however, is reduced considerably because of the recycling and the use of secondary fibers.

The most significant point is that nonpackaging paper will contribute a proportionately higher volume to solid waste in 1976 than in 1966 (see Table 34). There are two primary reasons for this change. First, the consumption of paper products that are of relatively short life is increasing more rapidly than that of longer-lived products. The rapid growth of sanitary tissue in relation to other papers is a good example. The second reason is that paper products will tend to become less valuable per unit as each person is exposed to an increasing amount of paper, particularly in printed form. Together with this factor, further technological developments will tend to put paper products into the waste stream more rapidly than in previous years, because the retention cycle will be shortened. This trend is reflected, in particular, in the fine paper grades where the solid waste profile for writing papers in 1976 is substantially accelerated over the profile for 1966. Microfilm and other techniques that put documents into more manageable form will have an increasing impact on business papers. While the impact of technology aimed at reducing the total bulk of paper consumed should begin to show its effect in 1976, accelerated disposal will still be more important.

The amount of paper and paperboard recycled is not expected to increase as rapidly as total consump-

TABLE 34.—*Nonpackaging paper entering solid waste stream: 1966 and 1976**

(In thousands of tons)

Grade	1966	Percent of 1966 consumption	1976	Percent of 1976 consumption
Paper:				
Newsprint	8,957	98.5	11,281	98.9
Printing paper	5,042	87.5	7,340	89.5
Fine paper	2,115	78.4	3,296	86.7
Special industrial paper	637	69.5	829	76.4
Sanitary tissue	1,937	68.6	3,395	72.7
Total paper	18,688	87.8	26,141	89.6
Paperboard:				
Special paperboard	630	33.1	954	37.4
Wet machine board	45	28.8	55	30.1
Construction paper	120	8.0	146	8.2
Construction board	191	7.7	295	7.8
Total paperboard	986	16.3	1,450	17.4
Total paper and paperboard	19,674	72.0	27,591	73.5
Nonwoven disposables	40	100.0	200	100.0
Total discarded	19,714	72.1	27,791	73.6
Paper and paperboard recycled†	5,378	19.7	7,200	19.0
Net entry to solid waste	14,336	52.5	20,591	54.8
Total discarded—lb per capita	200	72.0	250	74.0
Net entry to solid waste—lb per capita	146	52.6	185	54.8

*Source: Midwest Research Institute.
†Includes only nonpackaging grades.

TABLE 35.—*Net paper and paperboard entering solid waste stream: 1966 and 1976**

(In thousands of tons)

Category	1966	1976
Packaging grades	25,107	36,895
Nonpackaging grades†	19,714	27,791
Total	44,821	64,686
Recycled paper and board	10,159	13,600
Net entering as solid waste	34,662	51,086
Lb per capita total	352	460

*Source: Midwest Research Institute.
†Includes nonwoven disposables.

tion. Therefore the net contribution to solid waste will be increasing because of the declining importance of secondary fibers to total consumption also.

Thus each of the factors cited above will contribute to a relative increase in the role that paper products play in solid waste. As a result, discarded nonpackaging paper will be a more significant factor in 1976 at 27.6 million tons than in 1966 at 19.7 million tons; this is an increase of 40 percent. In pounds per capita, discarded paper will increase from 200 lb in 1966 to 250 lb in 1976, a net change of 25 percent. During the same period, total consumption of nonpackaging paper will increase by slightly less than 38 percent. By either comparison, paper will have a proportionately greater impact on solid waste in 1976 than it did in 1966.

Net entry to solid waste in 1976 is even more important. Assuming that only recycled nonpackaging paper is deducted from total nonpackaging paper discarded in 1966, then 72.7 percent entered the solid waste stream in that year; by 1976 this percentage will increase to 74.1 percent (Table 35).

By any of these measures, the amount of nonpackaging paper discarded will have a greater impact on solid waste facilities in 1976 than it did in 1966. This impact will come not only from an increasing per capita consumption of paper but also from an accelerating rate of discard, with proportionately less being recycled as a raw material. Paper and paper products are destined to be of growing concern to those responsible for handling the Nation's solid wastes in the years ahead.

Salvage and Reuse of Nonpackaging Paper

In the past, the paper industry has recycled a substantial portion of its waste paper product for use as raw material. This material is thus removed from the solid waste stream and constitutes a substantial reduction in the quantity of paper that might otherwise be handled as solid waste. In 1966, a total of 10.2 million tons of paper stock (waste paper) was consumed by the paper industry in the manufacture of all paper and paperboard grades. This amount is about 21 percent of the total raw material fiber required by the paper industry during the year. Of this, we estimate that 5.4 million tons were of nonpackaging grades.

The paper industry contributes substantially to waste reduction and conservation of materials. However, this contribution, as a percent of total tonnage consumed, has declined substantially over the years —from 35 percent of total fiber in 1946 to 21 percent in 1966.

There are several reasons for this decline in the relative importance of paper stock in recent years. Among these reasons are the increases in contamination of paper by coatings, special inks, varnishes, clay coatings, adhesives, laminates, and the like; increased costs of collection and high labor costs of separation; large additions by the paper industry of captive virgin pulp supplies; and advances in paper-making technology based on virgin fiber processes. It is unlikely that these conditions will change in the next few years, even though the reclaimed quantities of paper stock should increase to a total of about 13.6 million tons in 1976 compared with 10.2 million tons in 1966. Of this amount, about 7.2 million tons will be nonpackaging grades in 1976, compared with 5.4 million tons in 1966 (Table 34). However, the percentage share of reclaimed stock should continue to decline, falling to about 19 percent of total fiber in 1976.

A recently published analysis of paper-stock composition gives the tonnage by paper stock grades for 1966 (Luey, 1967). This study was used by MRI to establish the portion that is of nonpackaging grades. The stock composition data enabled us to estimate the proportions of reclaimed waste that came from paper conversion and from other industrial, commercial, and residential sources (Table 36).

It can be readily observed that among nonpackaging grades, newsprint is reused in substantial quantities and that other nonpackaging paper stock grades are derived primarily from paper manufacturing and converting operations, printing and publishing operations, and business and commercial sources, such as retail stores. In addition to newsprint, the grades most often recovered are fine paper, printing paper, bristol, and tab card stock. Newsprint constitutes over 39 percent of nonpackaging stock recovered, the mixed grades another 30.5 percent, and the tab card bristol grades another 19 percent.

Most of the total paper stock reclaimed—about 85 percent—goes into the manufacture of paperboard grades; only 15 percent is used for paper. The nonpackaging grades absorbed only 38.2 percent of total paper stock consumed in 1963 (Table 37) but contributed about 50 percent of the total tonnage of paper stock. Thus the nonpackaging-paper stock grades make a proportionately greater contribution to paper reuse than do packaging grades. The packaging grades (primarily container board and bending board) consume a greater proportion—about 62 percent of total paper stock used in paper manufacture.

Some segments of the paper industry and the secondary materials industries have been active in developing salvage and reuse technology and economies to accommodate continued use of secondary fibers as raw materials. For example, the Technical Association of the Pulp and Paper Industry (TAPPI) has pursued an interest in deinking techniques and technology, as well as in secondary-fiber use in general (about 10 to 15 percent of all paper stock is deinked today, primarily newsprint and printing grades). The Paper Stock Institute of the National Association of Secondary Material Industries, Inc., has also been an active participant in promoting greater use of paper stock. The Paperboard Group of the American Paper Institute

TABLE 36.—*Paper stock recovered for use in paper manufacture by paper stock grades: 1966**

Paper stock grades†	Description	SIC equivalent	Thousand tons		Percent of total	Percent nonpackaging	Primary sources§
			Total	Nonpackaging			
#1—#5	Mixed; boxboard cuttings; mill wrappers..	—	2,740	1,640‡	27.0	16.1	A, C, D
#6—#8	News	262111	1,930	1,930	19.0	19.0	B, C, D
#10—#11	Corrugated	26311	2,640	—	26.0	—	A, C
#12—#21	Unbleached kraft	26216 26311	580	—	5.7	—	A, C
#22—#23	Groundwood shavings	26212	325	325	3.2	3.2	B
#24—#26	News blanks	262111	174	174	1.7	1.7	B
#28—#29	Soft white shavings	26215	91	91	0.9	0.9	A, B
#30—#33	Hard whites and envelopes	26215	71	71	0.7	0.7	A
#35—#37	Tab cards and manila cuttings	2621759 26216	223	223	2.2	2.2	A, C
#38—#39	Ledger, colored and white	26215	750	750	7.4	7.4	A, C
#40—#43	Magazines and books	26212 26214	174	174	1.7	1.7	B
#44—#45	Bleached kraft cuttings	26216	265	—	2.6	—	A
Other		—	196	—	1.9	—	A, B, C, D
			10,159	5,378	100.0	52.9	

*From Midwest Research Institute based on an analysis of grades of paper stock used in 1966, developed by A. T. Luey, Manager, Boxboard Research and Development Association.

†Paper stock standards of the National Association of Secondary Materials Industries, Inc.

‡These mixed grades contain a variety of paper grades and quality. Mixed paper grades typically come from offices and other commercial sources. The quantity shown is an estimate of the fine paper, printing paper, and newsprint portion of the total of grades 1–5.

§A: paper mills or converters; B: printing, publishing; C: commercial or industrial; D: residential. These sources apply to the paper stock grades and at the stage of processing or use in which the discarded paper is recovered.

TABLE 37.—*Consumption of paper stock (waste paper) in production of new paper: 1963**

Grade	Percent of total paper stock consumed by weight
Paper:	
Newsprint	0.31
Groundwood, uncoated	0.43
Coated printing and converting paper	2.74
Book paper, uncoated	2.60
Fine paper	1.01
Special industrial paper	1.69
Sanitary and tissue paper	4.82
Total nonpackaging grades	13.60
Total of packaging grades of paper	1.33
Paperboard:	
Nonbending board, special paperboard, cardboard, and wet machine board	15.37
Construction paper	8.26
Hardboard and insulating board	1.01
Total nonpackaging grades	24.64
Total of packaging grades of paperboard	60.43
Percent of total paper stock consumed in nonpackaging paper and paperboard	38.24
Total all grades	100.00

*From U.S. Census of Manufacturers 1963, Pulp, paper, and board mills, table 7C, 26A-31. Modified by Midwest Research Institute.

through its National Committee for Paper Stock Conservation has shown substantial interest in maintaining supplies of paper stock. (This organization was instrumental in establishing an experimental program in Madison, Wisconsin, in mid-1968 to recover newspapers from residential sources as part of refuse pickup operations and to use them as secondary fiber furnished to nearby paper mills.) A large number of paper companies, as well as paper stock dealers and brokers, actively pursue the economic recovery and reuse of secondary fibers.

In recent years there have also been advances in technology from machinery manufacturers who supply balers, shredders, conveyors, and paper stock handling systems. One company, Daffin Corp., Hopkins, Minnesota, has been developing a pelletizer that promises to reduce greatly the volume of paper stock and to increase its density, which will result in substantial freight, handling, and use advantages. Riverside Paper Corp., Appleton, Wisconsin, has recently developed a system for removing polyethylene and wet-strength resins from coated papers.

The above are only isolated examples of recent advances in technology that appear quite promising. Paper stock recovery continues to be one of the best potentials for reducing solid waste volumes. Recent renewed interest of the paper industry in these fields offers some hope that resource conservation through economic recovery of secondary fibers will make a greater contribution to reduction of solid waste quantities than it has in recent years.

APPENDIX

DISPOSAL MODES USED FOR NONPACKAGING PAPER

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APPENDIX

DISPOSAL MODES USED FOR NONPACKAGING PAPER

Any analysis of the impact of nonpackaging papers on solid wastes would be incomplete without some discussion of the methods by which these papers are disposed of. There are five basic methods, three of which are important to the disposal of nonpackaging papers discussed in this report. The three most important methods are given first. Paper quantities judged to be in the latter two categories were excluded from the waste calculation developed in the analysis.

(1) *Disposal in recognizable bulk.* This classification applies to most of the nonpackaging grades and is the most important. It includes all paper and paper products that are recognizable as such when they are discarded. Examples are newspaper, periodicals, office forms, business papers, and tissue paper.

(2) *Disposal by recycling.* This is mill-consumed paper and paperboard and does not enter the solid waste stream, because it is recycled for use as a raw material in the manufacture of more paper and paperboard. In this analysis it has been shown as a net deduction from the total paper discarded in any one year.

(3) *Disposal by water carried systems.* Paper normally disposed of in municipal sewer systems is included here. The only item of significance in this study is toilet tissue, a portion of which is digested during treatment, but which also may enter solid waste as a component of sewage plant sludge.

(4) *Disposal in secondary form.* This mode applies to paper used in other products. The paper is generally not recognized as such when it reaches the disposal stage. Typical products of which paper is a hidden part are shoes, electrical cable, and vulcanized rubber products. This mode also includes paper that becomes a part of solid waste usually classified separately. Thus, construction paper and construction board normally end up in building rubble, and automobile panel board ends up as a part of scrap automobiles. None of the paper and paperboard grades classified in this mode have been included in the solid waste quantities calculated for 1966 and 1976. They were classified under the diverted category.

(5) *Disposal by burning in use.* This mode applies to a very small quantity of paper products, primarily to cigarette papers.

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